Current Studies in Digital Transformation and Productivity

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PREFACE

This book was prepared from the selected academic research and review studies invited by the editors. The objective of the book is to reveal the recent advanced applications of digital transformation and to provide the readers with the opportunity of a scholarly refereed publication in this field. In addition, this book consists of 11 chapters (24 authors in total) which were a collection of the recent research efforts for understanding the current state of the literature and giving deep enough insights into the field. It was published under the leadership of The International Society for Research in Education and Science (ISRES) Publishing which is the status of "Recognized International Publishing". At the same time, all submissions were reviewed by at least two international referees and selected by the editors. The target audience of the book covers scientists, experts, M.Sc. and Ph.D. students, postdocs, and anyone interested in the related subjects covered. This book and the individual contributions contained in it are protected under copyright by the Publisher. Finally, we wish the book will present curiosity about Digital Transformation and Productivity, we wish the book will be useful for new scientists, science readers, and anyone who intends to learn about the mystery of science.

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IN THIS BOOK

In Chapter 1, the conceptual framework of digital transformation has been discussed in general. In this context, first of all, the basic elements of digital transformation which are individual, process, and technology was examined in detail. Then, the concepts of the digital information age, digital competence and digital literacy, digital society, and digitization are emphasized. In the next section, Strategies of Digital Transformation (use/utilization of technologies, changes in value creation, structural/formal changes, and financial situations) were explained. After these explanations, each of the Challenges of Digital Transformation (priorities, aggregate data or personalize, providing more resources to its staff vs. more self-service analytics, storing all data vs. selecting data to store that serves a specific purpose, work performed by people vs. computing machines, security vs. accessibility, the privacy of individuals vs. understanding of an individual) were covered in detail. In the last section, there are conclusions and recommendations drawn from the study.

In Chapter 2, information about Digital Transformation and Technologies Shaping the Digital Transformation. In this context, virtual reality, augmented reality, artificial intelligence, data mining, big data, digital media, the internet of things, cyber security, mobile and cloud computing concepts are explained. Based on these technologies, it can be said that all technological developments started with digitalization and then each development triggered the next development. These developments have made change and transformation inevitable in different fields. The relationship of these technologies, which make change and transformation inevitable in different fields, with digital transformation, were discussed.

In Chapter 3, aims to summarize digital transformation and productivity-related documents using the bibliometric analysis technique. Bibliometric analysis is the numerical examination of the publications produced by individuals or institutions in a certain field, period, and region, and the relations between these publications. Thanks to the bibliometric analysis, popular keywords, authors, researchers, publishers, organizations, and countries were identified and the general status of the digital transformation and productivity field was determined.

In Chapter 4, the increasing data volume, velocity, variety, etc. with the spread of digital technologies, the transition process from data mining to big data, and its effects on digital transformation are mentioned. In the chapter, the importance of data mining and big data for digital transformation is mentioned, and the concepts of data mining and big data are explained in detail. By mentioning the contributions of these disciplines to digital transformation, the contributions of data analysis processes to productivity are also explained.

In Chapter 5, with the effect of rapid advances in communication and technology, it has become a necessity for businesses to keep up with the times. With the development of the digital age, transformation activities in businesses need to be carried out rapidly. How the digital transformation will be carried out and how the digital transformation strategy will be implemented is a matter of curiosity. In this study, it is tried to present a roadmap on how to realize the data, innovation and competition process within the scope of digital transformation. In this context, it has been tried to include the process, difficulties encountered, solution suggestions, digital transformation strategy and application examples in the subjects of data, innovation and competition of digital transformation. The study is important in terms of being a guide for businesses to realize digital transformation.

In Chapter 6, the adoption and success of e-tax services, which is one of the most important application areas of e-government, has been the subject of research. The Interactive Tax Office, which is one of the most used e-tax services by taxpayers in Türkiye, was chosen as the object of examination. In the study, the factors affecting the adoption and success of the Interactive Tax Office were tried to be determined with the help of the Information Systems Success Model.

In Chapter 7, the relationship between 5G and beyond networks, namely, the next-generation networks and digital transformation, is examined. In the digital transformation era, the effects of next-generation communication technologies in many different digital sectors and how they affect productivity in these sectors are explained. In addition, it provides a comprehensive study of how 5G and beyond communication technologies and other digital technologies affect each other's productivity.

In Chapter 8, information is given about blockchain technology, which enters our lives rapidly and provides solutions that make life easier in many areas, and the digital transformation it has carried out. Within the scope of the study, the contribution of blockchain to digital transformation was mentioned and information was given about blockchain-based theoretical and applied applications in many fields such as supply chain, finance, education, and health. These applications, which are increasing in number and spreading rapidly, have brought about development and transformation in different sectors.

In Chapter 9, how the communication and social processes within the organizations inhibit effective digital transformation is examined. These processes act against the best intentions of the organizational actors and operate outside the awareness of the related parties. The existing advice regarding the effective implementation of digital transformation bypasses these processes. It is hypothesized that without surfacing and engaging these hidden pitfalls the transformation efforts are bound to fail or become unnecessarily difficult and costly.

In Chapter 10, information is given about the effects of virtual and augmented reality applications on the education of the disabled. Virtual and augmented reality can be defined as the representation of computer-generated sound, text, 3D images, or graphic data in a real physical environment. It is an important technology for disabled people to continue their education effectively in their environment. Many studies are carried out for the positive effect of these technologies on the education of disabled individuals and many applications are developed for the education of these individuals.

In Chapter 11, the importance of efficiency, which is one of the reflections of digital transformation on higher education institutions, is emphasized. In this context, the trend in the literature on the concept of digital transformation and efficiency in higher education has been revealed. Various analyzes (distribution by years, distribution by publication language, distribution by publication type, distribution by country, distribution by keywords, three-field analysis, thematic map, factorial analysis) were carried out with bibliometric and data mining methods, and the education on this subject was revealed.

Managing Editors

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CHAPTER

A Conceptual Framework of Digital Transformation

1

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A Conceptual Framework of Digital Transformation

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Introduction

The concepts of digital transformation or digitization are widely used in almost every field today. The term digital is derived from the word digitus (Latin: finger) and means digitization. Digitalization first emerged as the automation of business processes with the use of software and later affected the business processes or business models of institutions thanks to many digital technologies. The digitalization process started with the digitization of analog data and the use of computers where digital data was managed. In summary, this process has been expressed as digital transformation with the rapid development of digital technologies and the integration of these technologies into systems/processes (Klein, 2020). At this point, digital transformation has become much more important with the decrease in resource use, demographic changes, globalization of markets, and increased international competition (Marquardt, 2017). The rapid technological change, which is also called the digital age, has made its effects felt in all areas and thus the concept of digital transformation has come to the fore. Using digital technologies, digital transformation enables users to develop new business models, make things easier, increase efficiency and improve processes (Tasci & Taslibeyaz, 2021; Wade, 2015).

According to another definition, digital transformation is the creation of new processes, innovative business models, smart products/services, and the integration of advanced digital technologies and digital systems (European Commission, 2019). Therefore, the basic elements of digital transformation are individual, process, and technology. In this context, digital transformation is a change by using digital technologies in order to facilitate the work (procedures, strategies, policies, etc.) of individuals (corporate employees, customers, etc.). This change affects individuals, structures, and strategies as a process that affects many areas (culture, health, agriculture, economy, industry, etc.) in line with the needs of society (Tasci & Taslibeyaz, 2021; Wade, 2015).

Digital transformation is defined as the process of creating value by utilizing digital technologies, strengthening social structures, and achieving efficient results thanks to digital technologies. However, transformation is not to completely eliminate the previous system, but rather to adapt the previous system to adapt to the transformation process and improve the existing system. According to this approach, transformation is important in order to process the collected data and achieve a better future by reaching wisdom from the information. Digital transformation is a process that includes many steps and covers business models, strategies, and technical and social dimensions of institutions. digital transformation; mobile applications, IoT platforms, sensors and automation, cyber security, 3D printers, digital twins and smart systems, big data, artificial intelligence, augmented reality, and cloud computing (Calp & Er, 2019; Kahveci, 2022; Bozkurt et al., 2021).

In general, digital transformation is a process of change that occurs with the integration of information technology environments such as social technology, cloud computing, and the internet of things, and is considered as the integration of digital technology with operational processes in the digital economy. It is also expressed as the ability of processes to innovate comprehensively to improve their business capacity. (Balli, 2022; White, 2008; Westerman et al., 2014; Liu et al., 2001).

Digital Information Age, Digital Competence and Digital Literacy

Knowledge is a relative concept in its nature and can be defined in different ways according to time, environment, context, and culture. Information is a concept that progresses by accumulation, is produced at a certain time, and grows exponentially. One of the reasons why information is increasing day by day is that information is easily accessible with technologies (computer, internet, and other online technologies, etc.), the barrier between users who want to access information and information sources is removed, and new information spreads rapidly. In this context, there are three phases that affect the change and transformation of societies. First, it is the agrarian society that replaces the hunter-gatherer society. The second is the industrial society in which the mass is effective. The third is the information society, which is called the post-industrial era. The distinguishing feature of the information society from other societies is that knowledge is the determinant of power (Bozkurt, Hamutoglu, Kaban, Tasci & Aykul, 2021). Digital transformation, which provides an opportunity to manage (perceive, obtain (collect), allocate, share and use (application)) of information, plays an important and facilitating role for the transformation to be achieved in business processes through information and culture (tasks, information flows) (Calp, 2020; Heilig et al., 2017).

Digital competencies are one of the most prominent concepts recently. Digital competencies can be developed in areas such as education, economic, political, and socio-cultural. Digital competencies are a level of literacy both to see the change in education levels as a result of digitalization and to support lifelong learning. It is very important to have digital competencies in today's world where the information structure is constantly changing and the information is increasing day by day. Digital competencies are defined as competencies required to live, work and learn in a digital society. Digital competencies consist of knowledge, skills, and attitudes. In this context, digital skills and competencies include performing certain functions using information and communication technologies and digital tools, managing information, collaborating, and sharing content by developing (Lissitsa & Chachashvili-Bolotin, 2019; Ilomäki et al., 2016). Digital competencies include knowledge, skills, and competence. However, digital competence covers both technical skills and behaviors (such as behaving, learning, and teaching) in the field of knowledge, skills, and competence through digital technologies (Tømte, 2013). When the digital competence concept map proposed by Ala-Mutka (2011) is examined (Figure 1), "Information and Communication Technologies Literacy" in the center, "Internet Literacy" in the upper circle, "Media Literacy", " Digital Literacy" and

" Knowledge Literacy" in the upper circle. It is seen that there is "Digital Literacy". This concept map also includes skills such as knowledge management, problem-solving, creativity, cooperation, personal development, responsibility, entrepreneurship, and critical attitude (Ala-Mutka, 2011).

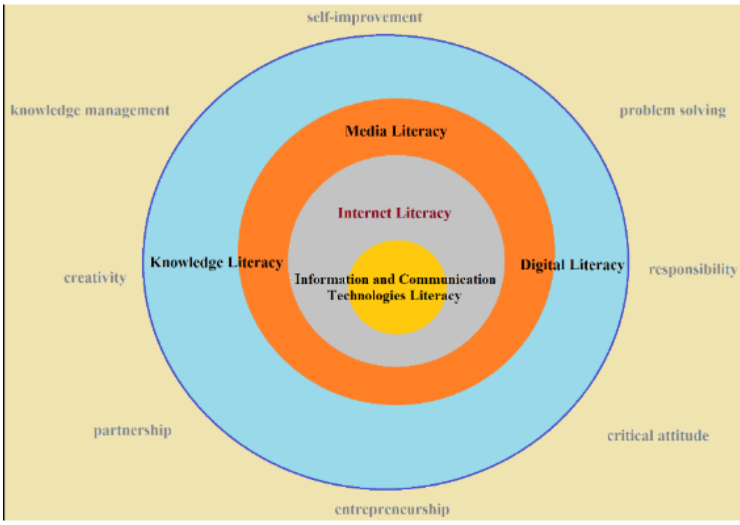

Figure 1. Digital competence map (Ala-Mutka, 2011).

Digital literacy involves a process as well as having certain technical, cognitive, and social-emotional skills. Digital literacy is defined as an "individual's ability to appropriately identify, access, manage, adapt, evaluate, analyze and synthesize digital resources, digital tools and possibilities, construct new knowledge, create media expressions and communicate with others, engage in constructive social actions in the context of private life situations, and reflecting in this process is defined as "awareness, attitude and ability" (Martin, 2005; Kazu & Erten, 2014).

Digital Society and Digitization

The digital society can be defined as an element that determines the basic characteristics of society and the society that occurs as a result of digitalization, or it can be expressed as the society in the digitalized world. Digital technologies and information that enable digitalization are produced by people (Bozkurt, Hamutoglu, Kaban, Tasci & Aykul, 2021; Martin, 2008). The change in digitization rates all over the world is increasing day by day. The change in question is above the world average in Türkiye. In the digitalized world with Society 5.0, it has been understood that technology can be used to ensure the peace, welfare, and benefit of society. Society 5.0 puts people at its center in the process of solving the problems experienced in information and communication technologies and ensuring sustainable technology development (Bozkurt, Hamutoglu, Kaban, Tasci & Aykul, 2021; Fukuyama, 2018).

When we look at the concept of digitalization, it is discussed whether this concept is a digital transformation or whether it is a different issue from digitalization. For example, while process automation is seen as the first digitization phase in some sources, it is argued in some sources that the digitalization and digital transformation phase have been passed in recent years, and digital transformation and digitalization are defined together. According to another definition, digital transformation is stated as the transformation of organizational strategies and structures with digitalization (Berghaus & Back, 2016). When the definitions related to digital transformation are examined, it is seen that digital transformation has a multidimensional change process and affects business models, job descriptions, customer relations, personnel abilities, and corporate culture as well as business processes of institutions. However, definitions of digitalization are very similar to definitions of digital transformation. At this point, the potential of digitalization activities in institutions to be realized on a larger scale with Industry 4.0 has led to the definition of digitalization with digital transformation. Depending on the development of digital technologies or digitalization, there are four digitization phases in institutions (Figure 2): These are the Personal computer phase, the Internet phase, the Social Media phase, and the Internet of Things Phase. Each phase is integrated with the other and uses the other's technologies (Klein, 2019).

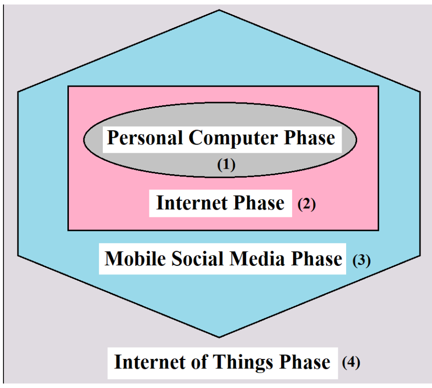

Figure 2. Digitization phases (Klein, 2019).

The first digitization phase, the "Personal Computer Phase", started with the digitization and transfer of data to digital media and continued with the automation of the processes. Thanks to automation, the business processes of organizations have been carried out faster and more efficiently (Savić, 2019). The development of data banks and network technologies has increased productivity and reduced costs (Klein, 2019).

The second phase of digitalization has begun with the use of the Internet and there have been some changes in the communication between the stakeholders (internal or external) of the organizations. Thanks to the Internet, organizations have gained easy access to information and have been able to share information effectively. In addition, the Internet has been an important factor for businesses to do electronic commerce (Wigand, 1997). Electronic commerce has moved some of the business value chains of organizations to the network environment and digitized it. Thus, new business processes and models have been developed. In the second digitization phase, the aim is to increase the efficiency of organizations. (Klein, 2019). The third phase of digitization (The mobile social media phase) has been on the agenda with the use of Web 2.0 technology and mobile devices in every field. Web 2.0 technology has made it possible to develop an interactive Internet environment in which the user can actively produce content. Web 2.0-based social media research and applications have taken their place in businesses in the third digitization phase (Liang & Turban, 2011). The digitalization phase of the Internet of Things started with the fourth industrial revolution (Industry 4.0). The integrated use of sensor and network technologies has enabled the establishment of cyber-physical systems in which objects can be monitored in the network environment and communicate with other objects. With Industry 4.0, not only the production processes of the enterprise, but the entire business value chain is changing. By analyzing all data obtained from customers, businesses provide access to customers with innovative business models and offer personalized services. The Internet of Things enables the development of collaborative, data-driven, and service-as-valued business models on the platform (Burmeister, Luttgens & Piller, 2016).

Strategies of Digital Transformation

Regardless of industry or business, digital transformation strategies can be expressed under four main headings. These are the ***use/utilization of technologies, changes in value creation, structural/formal changes, and financial situations.*** The use/utilization of technologies addresses an enterprise's attitudes towards new technologies and their use skills. The use of technologies addresses an enterprise's attitudes towards new technologies and their use skills. Thus, it includes the strategic role of a business for IT and technological purposes. A firm needs to decide whether it wants to become the market leader in terms of technology use, whether it chooses to create its own technological standards or refer to already established standards, and whether it sees technology as a means of carrying out business operations.

The use of new technologies is generally understood as changes in value creation. This shows the impact of digital transformation strategies on firms' value chains. In other words, it reveals how new digital activities differ from traditional/analog business processes. Considering new customer segments and other markets, digitizing services and products enables different forms of revenue generation and streamlines business processes for businesses. Structural changes are often needed for new processes/operations, with different technologies currently used and different ways of creating value. Structural changes are driven by changes in the functional and organizational structure of a business, particularly integrating new digital activities into the corporate structure. If the scope or scope of these changes is limited, it may be more appropriate to integrate new business models, processes or operations into existing organizational structures. However, the previous three dimensions can be transformed only after taking into account the financial aspects. These include the urgency to take action based on an organization's ability to finance the expenditures it makes in the digital transformation process. Financial aspects are a limiting force for transformation and change. Low financial pressure on the core business may fuel perceived urgency, while companies already under financial pressure may lack external means of financing a transformation. Therefore, businesses should stand firm against the need to realize digital transformation and identify alternatives clearly and at the right time (Calp, 2020; Matt et al., 2015).

Challenges of Digital Transformation

Most businesses are performing the appropriate digital transformation to compete and survive. He noted that executives are digitally transforming three key areas of their business: customer experience, operational processes, and business models. At this point, some difficulties are encountered in the digital transformation process. These challenges can be summarized as follows (Calp, 2020; Westerman et al., 2012; Tiersky, 2017; Panetta, 2016; Newman, 2016; Davenport & Kirby, 2016; Filkins et al., 2016; Bharadwaj et al., 2013).

Priorities

The first dilemma is whether improving the efficiency of existing operations is a top priority or whether customers and meeting needs are the focus. The two tasks can be incompatible, and focusing on efficiency can reduce customer satisfaction, customer loyalty, and purchases.

Aggregate Data or Personalize

Emphasizing predicting customer behavior can lead to model searches and ignoring serving individual customers. Meeting needs often require personalization, while too much emphasis on patterns and customer categories leads to personalization. Normally, managers will pay attention to the interests and needs of customers and employees and will understand and serve the individual.

Providing More Resources to IT Staff for More Self-Service Analytics

Both IT staff and non-IT staff require more resources. More data scientists and IT staff are harder to return than more training and resources for managers and staff in functional areas.

Storing All Data for Selecting Data which will be Store that Serves a Specific Purpose

All data can be stored at a cost. It is much more difficult to understand which data to select and available for analysis. While finding opportunities to aggregate data sources, indexing data sources, and assessing data quality presents even more challenges. Data is both an opportunity and a problem. Unused or unavailable data is worthless.

Works Which Done by Humans Versus Computer Machines

Information machines and robots will continue to replace unskilled and semi-skilled workers. The ongoing transformation that includes Q/A bots, personal assistants, and decision automation shows that skilled workers can be replaced as well.

Security and Accessibility

It can be easy to access and use force data. Administrators must balance data importance and sensitivity with accessibility concerns. This is a real dilemma in healthcare.

Confidentiality of Individuals Against the Understanding of Individuals

While digital transformation has its challenges, current research shows that the digital phenomenon is an opportunity to innovate and redefine the way organizations do business.

Conclusion and Recommendations

Knowledge is a key element of change and transformation in the digital age or digital society. Since information grows and determines the balances day by day, it is very important today and digital transformation should be applied in every field. Digital transformation is a comprehensive change that will affect all business and functioning of organizations, models, leadership understanding and working styles, supplier, customer and employee relations, and organizational structure. Therefore, there is a need for a strategy, understanding, and roadmap that will successfully understand and manage this process of change and transformation. In order to create a useful digital transformation strategy and implement this strategy effectively, organizations need to know how they want to transform, and what their goals and expectations are. The realization of the transformation is only possible with the combination of different elements. Because there are some difficulties or threats in the transformation process.

In order to turn the threats or crises encountered in the digital transformation process into opportunities, these difficulties must first be defined correctly and these problems must be solved completely. In addition, it is important to carry out theoretical and practical studies by providing coordination toward digital transformation and digital literacy. It is very important to have a fast and efficient digital transformation strategy with innovative technologies in order to survive in the developing and changing world. In this context, technologies such as forecasting and analysis, artificial intelligence control, machine learning, design and development, big data and analysis, cloud computing technologies, blockchain technologies, internet of things (IoT), and RFID is expected that will be used extensively in every field in the near future within the framework of digital transformation.

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CHAPTER

2

Technologies Shaping the Digital Transformation

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Introduction

Anything that can be expressed in a binary number system can be called digital. In this system, the operations that can be done through 0 and 1 are expanded and the borders are removed. By expanding the scope, the data can be easily reproduced and transferred at a cost close to zero without any distance limit (Acungil, 2018). The process of transferring a job, resources, or service to the digital environment is defined as digitalization. With digitalization, the speed of access to information has been significantly increased by compacting information into small spaces and making it portable (Aksu, 2018). Music, books, photos, money, etc. in various fields. The concept of digitalization, which emerges with the change of different components, brings with it various technologies.

The concept of "digitalization" has been explained above. Digital literacy, on the other hand, can be defined as the ability to use digital technologies in the digitalizing world, to access information with the help of digital technologies, to test the accuracy of the accessed information, and to use the accessed information correctly. These aforementioned capabilities enable users to communicate in different ways while facilitating learning. Digital literacy enables users to access information quickly, regardless of time and place.

With the introduction of the concept of digitalization into our lives, various concepts in the social context have been developed and brought to the literature. In recent years, with the development of technology, there have been differences between generations, and concepts such as digital natives, digital immigrants, and digital hybrids have been developed to reveal these differences.

Individuals who can easily use information and communication technologies and adapt to new technologies are called digital natives (Prensky, 2001 as cited in Karabulut, 2015). Five different aims of digital natives in using technology are mentioned (Waycott et al., 2010). These purposes were conveyed as personal interest, social communication, daily use, professional work, and course homework. Individuals who try to adapt to information and communication technologies are called digital immigrants, unlike digital natives, whose tools, technology, and speed of access to information have developed and gained an advantage. The study of Prensky (2005) can be given as an example to reveal the difference in the use of resources between digital natives and digital immigrants. As reported by Prensky (2005), while digital immigrants refer to the user manual before starting to use a new tool device digital natives prefer to discover and learn on their own (Bilgic et al., 2011). Similarly, while digital immigrants use physical libraries to access information, it is emphasized that digital natives receive support from social media applications and forum sites where information is shared rather than physical libraries (Tonta, 2009).

Digital transformation, which includes the concepts of digitalization and digital literacy, is a holistic transformation in people, technology, and business processes to increase service quality, reduce workload and ensure customer satisfaction in organizations in line with technology and needs (Aksu, 2019). With the invention of the Internet, in addition to money, music, books, and newspapers that affect our daily life, the digitalization process has begun in organizations and businesses. This digitalization process has made the digital transformation of people, technology, and business processes inevitable with the development of information technologies.

Technologies

Virtual Reality and Augmented Reality

Virtual Reality (VR), which is transferred as a simulation model, is the platform where the feeling of reality is created with the dynamic communication environment created through various devices (Primental & Teixeira, 1993). These platforms, which first emerged in the game and entertainment sector, are used in various simulations in the field of education, in virtual markets in the field of marketing, and in various applications where the field of view is controlled in the manufacturing sector (Bayraktar & Kaleli, 2007). In applications based on VR technology, users are cut off from real life and an abstract environment is presented. Unlike this abstract environment, virtual objects and images are added to real-life images in augmented reality applications (Icten & Gungor, 2017).

In 1995, VR glasses called Virtual Boy were started to be used in the entertainment industry by Nintendo Company. It is stated that this product developed by Nintendo Company for its game consoles is the pioneer of the studies. In the following years, the scope of personal experiences was expanded with the development of Head Mounted Displays. Smartphone users are offered different experiences with the Gear glasses developed by the Samsung Company. With the various sensors used in these glasses, the ambient sounds change along with the images.An abstract environment is presented with images and sounds that vary depending on the user's head movements (Ferhat, 2016).

It is stated that the idea of augmented reality, which consists of components included in real life, unlike virtual reality applications, dates back hundreds of years. (Ozarslan, 2015). However, the term VR was first coined by Thomas Caudell and David Mizell. (Altınpulluk & Kesim, 2015). It is aimed to guide the workers in the cable connections with the digital imager developed for the Boeing Company. This image, which is used in production and engineering processes, has also been used in the training of workers (Thomas & David, 1992). One of the areas where augmented reality technology is first used in the military field. The flight data was displayed with transparent screens integrated into the pilots' helmets (Livingston et al., 2011).

Wearable technologies, simulations, computers, and cameras form the basis of augmented reality applications. In the following years, augmented reality applications have differentiated with the development of mobile devices and software with the internet (Altınpulluk & Kesim, 2015). Today, in addition to military applications, it is used in various fields such as education, entertainment, and marketing. Within the scope of Digital Transformation, the effectiveness and efficiency of augmented reality applications are increased with the studies carried out in the field of Human-Computer Interaction, especially with the transformations in processes and technologies.

Artificial Intelligence

Artificial Intelligence (AI), a branch of computer science, deals with transferring the characteristics of intelligent living things to systems and devices. The characteristics of intelligent creatures are generally based on their thinking and behavior. Studies based on transferring rational behavior and thoughts to systems can be called AI (Winston, 1991).

It is stated that AI studies started with the Turing test developed by Alan Turing in 1950 (Tas & Mert, 2019). In the Turing test, various questions were asked and the answerer's state of being a machine or a human being was mentioned (Turing, 1950). The Turing method is based on data storage, unlike the first computers produced to solve a specific problem. This process has become the basic approach of computers in the following process. This situation, which offers the opportunity to store and change data, unlike the function of the first computers, can be considered the beginning of learning or thinking in the computer world (Yavuz, 2019).

Differences can be seen in evaluating research or system within the scope of AI. In this context, deciding whether a system is intelligent or not is based on humane-rational thoughts and behaviors. In addition, adaptability to unexpected situations is the indicator that distinguishes intelligent systems from classical approaches. This difference can be better demonstrated by considering the Classical Computing approach and the Artificial Intelligence-Based Computing approach. In the classical approach, the software has an algorithmic structure and quantitative solutions are produced. In addition, solutions cannot be produced for situations that are not included in the algorithm using a numerically addressed database (Firebought, 1989). The classical information processing of a general-purpose computer is given in Figure 1.

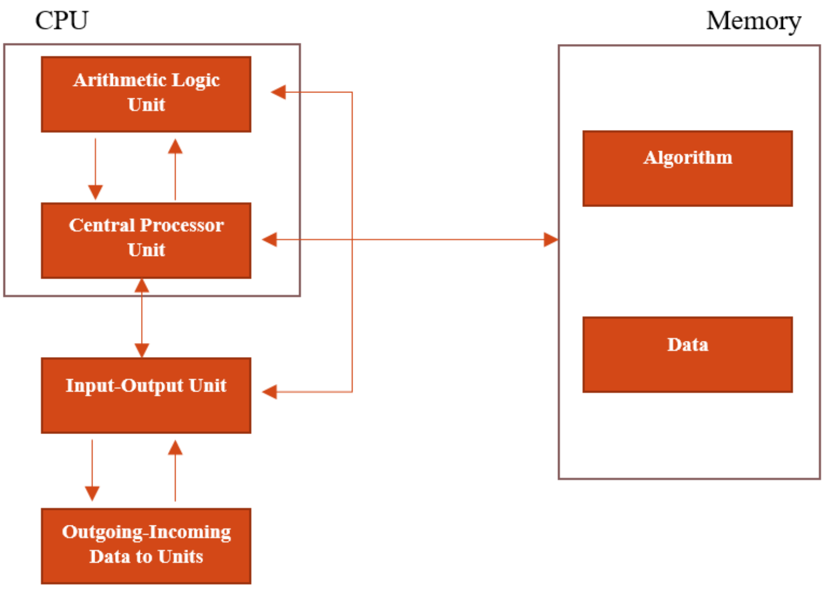

Figure 1. Classical Information Processing

Different from the classical computing approach shown in the figure, the way the systems based on the artificial intelligence approach work is given in Figure 2.

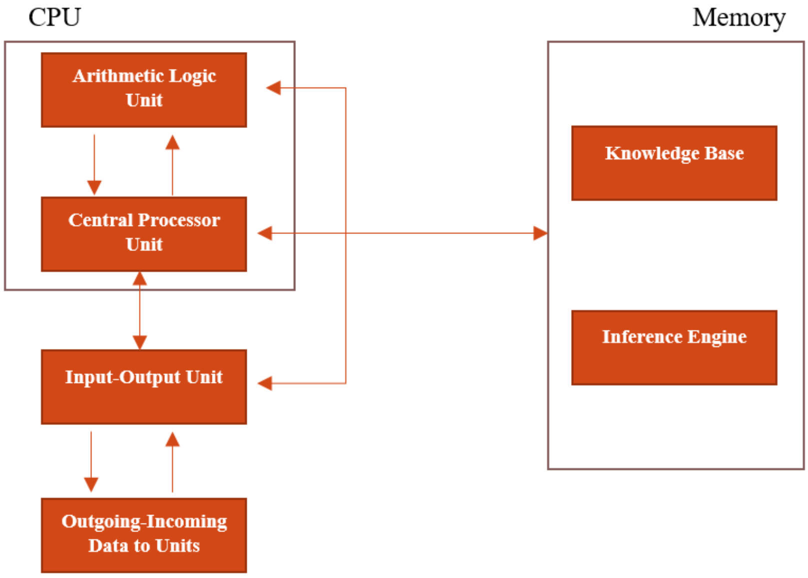

Figure 2. Artificial Intelligence-Based Computing Approach

As seen in the figure, the main difference between the Artificial Intelligence-Based Approaches from the classical computing approach is the knowledge base and inference engine. Spatial information, which is the basis of the artificial intelligence approach, is presented symbolically. These symbols that represent motion, action, object, or anything are made up of character sets. These character sets also form the knowledge base. A method is also needed to analyze the knowledge base obtained depending on the problem. This method, which is designed to make decisions in line with the information in the knowledge base, refers to the inference engine. It is aimed to reach the result by evaluating by including the external data together with the information in the knowledge base (Frost, 1986).

To solve problems with a certain algorithmic structure, data with certain properties are needed. For this reason, algorithmic techniques may be lacking in solving unpredictable and uncertain problems. The artificial intelligence approach, which has a wide application area, provides benefits in solving problems that are not suitable for a certain algorithmic structure. Today, artificial intelligence techniques are used to solve problems that are encountered in different fields and require adaptation. It is among the technologies that make a great contribution to digital transformation in the context of business processes, commercial activities, and technological developments.

Data Mining

In order for the data to be processed and converted into information and then information, it must be rendered operable (Davenport & Prusak, Working Knowledge: How Organizations Manage What They Know, 1998). These data are especially digital data. Digital data are collections of data that are transmitted, stored, and processed with software in an electronic format. Digital data is stored in the computer environment by converting it to a binary number system (1-0), which is the computer language so that it can be stored on HDD, SSD storage devices. Digital data is produced by a variety of devices such as desktop computers, laptops, tablets, mobile phones, and electronic sensors (Berksoy, 2019).

Big data consists of digital data. However, traditional databases and traditional analysis methods are not enough to manage big data and make it useful and accessible to users (Zikopoulos, 2012). And, as in the characteristics of big data, the data obtained must go through Data Mining applications in order to add value to an organization and provide a benefit to the organization. Today, every job and every action can be the subject of data mining (Toptas, 2021). Data mining is defined by Büncher, Anand, and Hughes as follows; "The discovery of previously unknown, understandable and useful patterns of particular importance in large data sets". Data mining has the ability to analyze billions of data. The main purpose of data mining is to make predictions for the future by analyzing the change from past to present with the available data (Bastos et al., 2014). For this purpose, different purposes are used in different fields such as education, health services, marketing, banking, production, retail, and insurance (Isik, 2022; Dincoglu, 2022). It has 5 characteristics: size, speed, variety, accuracy, and value.

Knowledge discovery in data mining refers to the discovery of previously unknown useful knowledge. The stage of reaching new information indicates that there are different numbers of steps in each source. As a result of the literature research, it was concluded that knowledge discovery was carried out in 8 steps, namely "Data Selection", "Data Cleaning", "Data Integration", "Data Selection", "Data Transformation", "Data Mining", "Pattern Evaluation" and "Information Presentation". The result can be deduced. In the knowledge discovery process, 60-80% of the time is spent bringing the data into a format to be used, while the rest is used for data mining.

One of the most important steps of data mining is data preprocessing, which is also involved in knowledge discovery. At this stage, the available data are prepared in a way that is suitable for use, meaningful, and of high quality (Gemici, 2012). As a result of processing with quality data, the error rate decreases, and quality outputs are obtained. Data preprocessing consists of 4 steps.

1. Data Cleaning; It is the phase of minimizing the noise in the data, correcting the inconsistencies in the data set, and detecting and removing the missing data.

2. Data Merge; It is combining data from different sources into a single source.

3. Data Transformation; It is the selection of the data mining model to be used and the conversion of the data set to that model format. Correction, generalization, merging, and normalization operations can be used in the transformation phase.

4. Data Reduction; It is the reduction of the data set in order to obtain effective outputs with data merging, data compression, size reduction, and discrete rendering methods.

In addition to these, certain common methodological steps must be followed before using one of the selected applications in data mining (Isik, 2022);

1. Determining the type of learning
2. Data mining algorithm selection
3. Selection of target variable
4. Data preprocessing
5. Data mining application
6. Analysis of outputs

Models in data mining are divided into predictive (supervised) and descriptive (unsupervised) models. With models, learning can be done with classification according to their functions, association rules, and sorting algorithms. Regression analysis and classification can be given as examples of predictive (supervised) learning, and clustering and association rules can be given as examples of descriptive (unsupervised) learning (Braha, 2001; Savas, et al., 2012).

1. Descriptive Models are the definition of the relationships between the data that affect the decision stage, and clustering and relationship analysis are the basic components (Yildirim, 2019).

1.1. Clustering is the process of breaking up data into different groups and clusters. As a result of fragmentation, subsets or groups that are similar in themselves are formed.

1.2. Association Rule; If there is a secret rule other than the predicted associations between two or more variables, this is the data mining method used to reveal potential relationships (Anane, 2001). The Apriori algorithm is "a method in which many iterative are performed to find frequently occurring item sets" (Isik, 2022).

2. Predictive Models, "is aimed to make predictions of datasets with unknown results by developing models from previously known data '' (Dincoglu, 2022).

2.1. Regression Analysis; reveals the relationship between the dependent variable and the independent variables in a fixed data set (Freedman, 2009).

2.2. Linear Regression: It is a linear approach that shows the relationship between a dependent output variable and one or more independent input variables. It is the most basic algorithm used for estimation (Freedman, 2009).

2.3. Decision Trees; It is used to predict output variables based on different input variables. It can also match nonlinear models very well (Beser, 2018).

2.4. Regression trees; It was formed by incorporating decision tree algorithms into regression models. It is designed to estimate functions that always have values instead of using classification methods on data (Isik, 2022).

2.5. CHAID and the Comprehensive CHAID Algorithm; this algorithm is based on the chi-square statistic and gives a probability value between 0-1. When two classes with a chi-square value close to 0 are compared, it is concluded that there is a significant difference, while it will be concluded that there is no significant difference between two classes with a value of close to 1 (Ramzai, 2020).

2.6. CART Algorithm; there are two important factors when the tree is branching; Purity and balance. While purity is determined by the Gini index.

Big Data

The Internet of Things (IoT), which has entered our lives with the development of sensor technology, was first mentioned in 1999. It is defined as the set of devices that communicate with each other using a specific protocol. Today, it is used in many areas, from smart city construction to small household appliances in our homes, from bracelets on our arms to military equipment. Smart devices that collect data in their environment, process it themselves when needed, and transfer it to another device are called Things. Most Things do not require human interaction to perform their functions. They communicate with other Things and exchange data with the information they receive from each other. In the advanced technology world, we exist in, change is progressing at a speed that cannot be kept up. While taking this speed on the path of technological change, it leaves behind collections of real crumbs that will contribute to the change of the whole world (Berksoy, 2019). A collection of real scraps is data, which is simply the rawest form of information. Data are facts in different forms that do not make sense on their own (Krishnan, 2013); facts in an individual's mind, photographs, drawings, and a table of survey results collected for a study, a printout of results (Pala, 2021). These data, which do not make any sense on their own, are extremely important to ensure the survival of an organization. Data traffic has grown at an unprecedented rate globally over the last 10 years as organizations become dependent on data in the 21st century (Deepa, et al., 2022).

The most basic data is structured and unstructured data, and there is also semi-structured data. Structured data is relatively more organized, readable, predictable, combinable, and can be analyzed with simple methods, queried, transformed into information using algorithms, and visualized data compared to unstructured data (Inmon & Linstedh, 2015). Structured data are data types that have multidimensional matrices but have regular forms, unlike unstructured data. Experts think that structured data covers 10% to 20% of the world's data (Hurwitz, et al., 2013). Unstructured data represents the opposite of structured data properties. They are irregular, unpredictable, unreadable, large, messy, and unrelated data types that cannot be represented by traditional table forms. And unstructured data have very different properties from each other (Pala, 2021). Considering the estimations in the literature, it grows 10-50 times faster than structured data (Simon, 2014). Semi-structured data, on the other hand, are some regular and some irregular data. An example of this is the survey data, the demographic part of the survey, namely date of birth, education level, etc. While the data is organized, the address or qualitative question data in the questionnaire are examples of unstructured data.

Unstructured data also represents a large part of what is called Big Data in the literature. 80% and 90% of big data consist of unstructured or semi-structured data (Gantz & Reinsel, 2011). Today, businesses direct their organizations by analyzing high-volume data in petabytes, exabytes, or zettabytes, not with data that would fit in a spreadsheet, database table, Gigabyte, or Terabyte. These data are called Big Data in the literature.

According to one source, the concept of big data was first used in the literature by John Mashey – Chief Scientist at Silicon Graphics in the early 1990s to reference the analysis and processing of large data sets (Ohlhorst, 2013). According to another source, the term Big data was named "Application-Controlled Demand Paging for Out-of-Core Visualization" presented by Michael Cox and David Ellsworth at the 8th IEEE Imaging Conference (Proceedings of the 8th Conference on Visualization) in 1997. There are rumors that it was used in the study (Cox & Ellsworth, 1997). Based on these sources and data, it is not possible to say in what time period big data emerged in real terms. While the data was at a size that could be entered manually at first, with the development of technology, these data, which needed petabytes, exabytes, and zettabytes for storage, began to be collected by various tools and ways. While big data was first collected by smart factories, smart cities, and smartphones, each individual has become a data source with the widespread use of social media.

However, the data sources that make up big data also vary. If we summarize them; In structured data, created by machines; human-generated data while sensor data, Web (Log) log data, point-of-sale data, and Financial Data; input data, Clickstream data, and game-related data. In unstructured data, machine-generated; human-generated data, while apparition images, scientific data, digital surveillance and sensor data; text files, email, social media, website, mobile data, communication, media, and business applications (Tykheev, 2018; Mohieldin, 2022). Providing data from various tools and sources has led to the formation of irregular and diverse data stacks.

Based on the diversity of data sources, it is seen that big data is data in extremely different forms and it is not possible to define this technology with a single accepted definition. Because big data itself is irregular and messy in terms of structure and features, big data could not be fully expressed in definitions. Therefore, there are many different definitions in the literature. Some of them are as follows; According to Manyika et al. (2011), big data dimensions are data sets beyond the ability of standard database software tools to acquire, store, parse and analyze information. Havens et al. (2012) briefly defined it as data of a size that we cannot load into the working memory of our computer. According to Wash (2013), it is the process of applying heavy computing power and the latest machine learning techniques to extremely large and often complex information sets. According to Kaur and Sood (2017), it is defined as a large variety of structured or unstructured data stacks with a volume too high for even state-of-the-art data processing platforms to handle. According to Davis (2014), big data consists of large data collections (large volumes) that are updated rapidly and frequently (high speed) and display many different formats and content (wide variety). Based on these definitions, big data can be defined as follows; Big Data is data stacks that cannot fit in traditional databases and spreadsheets, are in different forms that cannot be analyzed with traditional analysis methods, have an extremely fast refresh rate, and extremely diverse data sources.

Considering the definitions of big data, it is determined that these three features, namely Speed, Volume, and Diversity, are frequently emphasized. In the literature, these three features that make big data different from other data draw attention. The first three dimensions used in the literature to characterize big data were named 3V (Speed, Volume, Diversity), and it was claimed that they became the basic dimensions of big data and were first presented by Laney in 2001 and by Ylijoki and Porras (2016). Later, these three dimensions were insufficient to characterize and describe the complex and dispersed structure of big data, and the number of new dimensions increased rapidly. Later, the Accuracy dimension was added by D. Snow (2012), the Value dimension was added by Gamble and Goble (2011), the Variability and Visualization dimensions were added by Seldon and Currie (2017) and the dimensions were considered as 7 Dimensions (7V). These dimensions mean:

Volume; It refers to the size of the data collected from various sources and converged at a single point.

Speed; It refers to the speed of data collection, transmission, and analysis.

Variation; It expresses the richness and diversity in the data structure (Gupta & George, 2016). That is, it consists of various unstructured and semi-structured data such as text, audio, video, geolocation, and internet data (clicks and log files) (Minelli et al., 2012;Mohanty, et al., 2015).

Truth; It is about big data being reliable, valid, accessible, consistent, meaningful, and transparent.

Value; It expresses the benefit that the big data set adds to the organization as a result of data analysis processes (Kusat, 2020). It can also be called obtaining the expected competitive advantage of the information obtained as a result of the analysis of the large data set (Pala, 2021).

Variability; It means the change of the information/meaning extracted from the data according to the purpose and limit of the analysis. In other words, it refers to constantly changing data (Mohieldin, 2022).

Visualization; It turns the result obtained as a result of large data set analysis into representative images that the end user will understand and deals with insights (Kusat, 2020).

The data with these 7 characteristics allows organizations to obtain future inferences and information about their operations, customers, and suppliers (Ebner, Buhnen, & Urbach, 2014), course suggestions to students by the analysis of their data, and suggestions for which courses to be opened for the next semesters (Ebner, et al., 2014). Desai, (2018) is used in various fields because it provides contributions. These areas can be listed as follows; Healthcare, Finance, Education, Telecom Sector, Food Industry, Retail Sector, Government Sector, Manufacturing, Business, and Marketing (Mohieldin, 2022; Mukherjee & Shaw, 2016; Desai, 2018; Manyika, et al., 2011).

Like every new technology, it offers advantages and disadvantages to big data usage areas. Before starting to benefit from this technology, the purpose and the expected benefit from the outputs obtained at the end of the use of this technology should be determined. Because, like every infrastructure technology, this technology has positive and negative sides (Davenport, Big Data at Work, 2014). If we list the advantages and disadvantages that the organization will provide in the use of big data, it can be summarized as follows (Toptas, 2021);

Table 1. Advantages and Disadvantages that the Organization will provide in the use of Big Data

Advantages	Disadvantages
• Cost savings • Time-saving • Developing new service/product tactics, offers • Supporting business decisions • To accelerate the decision processes.	• Lack of "data analysts" who can keep up with technology "real-time", the need for rapid analysis of data • Data synchronization and lack of models, Rapid data refresh, and fast data flow • The security dimension of Big Data • Data privacy • Privacy of data

It can be listed up to this part of the article, data, structured data, unstructured data, semi-structured data, big data, big data sources, big data definitions, big data features, big data usage areas, advantages, and disadvantages are explained. After this section, how to store and analyze these stored data will be mentioned.

Digital Media

With the emergence of internet technology and the rapid development of communication technology in the 21st century, unimaginable new communication and interaction environments have entered the lives of individuals. Many concepts such as social media, digital media, and social networking have been included in the literature. These concepts have become an indispensable part of the lives of individuals in today's century and have caused changes in sociological, economic, and cultural fields.

LevManovich traces the emergence of the concept of new media to the 19th century. This process continues from the invention of Louis Daguerre's "daguerreotype" and Charles Babbage's "analytical machine" to the development of modern digital computers (Baslar, 2013). While the development in computer technology started with the invention of the analytical machine, it has been witnessed that moving images, text, and sound are stored using different formats in media technologies with "daguerreotype". With the combination of the development of these two inventions and the transformation of existing media into data, new media has emerged. At the same time, it has developed and brought concepts such as digital media and social media.

The concept of digital media is used to indicate that traditional media is a digital form. Digital media has high speed, interaction, and simultaneous communication features. Digital media, which has these features, offers individuals the opportunity to access, disseminate and communicate interactively, regardless of place and time (Demirel, 2018). In this case, digital media, as a large-scale communication revolution, introduced individuals to communication environments and communication types that they could not imagine. There have been many studies that distinguish digital media from traditional media. The common features extracted from these studies are as follows (Demirel, 2018; Van Dijk, 2016);

- Modularity
- Hypertext
- Interactivity
- Digitality

In summary, digital media has strengths such as sharpness, geographic reach, selectivity, storage capacity, and speed. Violation of privacy is the weakest feature of digital media (Van Dijk, 2016). Digital media has become indispensable for the societies we live in and is divided into platforms with different features under the concept of social media. The distribution of users in the social media platform generally determines the age and which platform the peers choose (Tas, 2019). With the development of digital media, the social media platforms developed are as follows;

Facebook; It is a platform that offers individuals the opportunity to share resources in different structures such as emotions, thoughts, memories, videos, and pictures (Tas, 2019).

Twitter; It is an application that allows individuals to share their feelings and thoughts by limiting them to 140 characters. Picture, video, etc. It can be shared in data, but the purpose of its emergence is text sharing.

Instagram; It is a social media platform founded on photo and video sharing of individuals.

Snapchat; It is an instant photo and video sharing platform. It disappears after the specified time or the specified number of views in the sent contacts. And it is stated by snapchat that these videos and photos are not stored.

YouTube; It is a social media platform founded on video sharing.

Websites; The first websites emerged 20 years ago (Erden Uzun, 2022). Web sites have recently been used frequently by organizations. It can be seen that almost every brand on any platform has a website. The reason for this is that the website offers the user the opportunity to express himself, express his corporate identity, vision, and mission more. In general, the websites of the institutions; It has been observed that it is used for purposes such as “presenting elements containing corporate identity, establishing two-way communication, making announcements, giving information, providing the opportunity to apply for a job, posting job advertisements, announcing human resources policies” (Oksuz, 2011).

These developments in the field of digital media have attracted individuals’ communication channels to social media platforms. The intention of each individual to continue social media has caused them to keep active on social media and has made social media an indispensable field. However, it causes changes in marketing strategies for organizations. It offered the organization owners the opportunity to observe their customers more closely through social media. It offers customers a wide variety of options for shopping. Therefore, with the concept of fashion, individuals are affected by each other and cause uniformity in clothing. Along with this, new occupational groups have emerged with digital media. Social media, which affects every field, can be said to be one of the most important factors that trigger the changes we experience today.

The Internet of Things (IoT)

The Internet of Things (IoT), which has entered our lives with the development of sensor technology, was first mentioned in 1999. It is defined as the set of devices that communicate with each other using a specific protocol. Today, it is used in many areas, from smart city construction to small household appliances in our homes, from bracelets on our arms to military equipment. Smart devices that collect data in their environment, process it themselves when needed, and transfer it to another device are called Things. Most

Things do not require human interaction to perform their functions. They communicate with other Things and exchange data with the information they receive from each other.

The Internet of Things ecosystem consists of four components. The Things Component, which refers to devices that are connected to the Internet, has sensors that provide data from the environment and a controller that sends the data to another device in the environment or to the cloud. The second component is called the Data Component. The data component is divided into two categories: Raw data and structured data. Raw data is unstructured data. In order to be used in the analysis and decision-making phase, it must be processed and displayed in a computer environment. The data that goes through all these processes is called structured data. The component that enables the transfer of data between devices or to the cloud is the Communication Component. Large amounts of data collected by things need to be processed to make it usable by humans. The fourth component, called the Human Component, enables data to be made meaningful through M2M (machine-to-machine), M2P (machine-to-human), or P2P (human-to-human) interactions.

The Internet of Things makes it possible to run ordinary processes automatically. It helps control processes that require more than one operation due to the connection of things (inventory management, transportation tracking, parts management, etc.). Processing the large amount of data collected helps companies develop business strategies, marketing, and promotional activities, and set pricing policies. It increases energy efficiency and reduces costs by making machines work more efficiently. Real-time data can also be used to predict faults in machines. The Internet of Things, used in the supply chain, ensures that products are tracked accurately, that action is taken quickly if a product is at risk, and that action is taken. Processing data on product usage will help the manufacturer and designer set the roadmap for new products with user experience in mind.

In today's world, where more than 70 billion devices are expected to be connected to the Internet by 2025, it is important to ensure the security of the Internet of Things, which has a widespread usage environment. Various types of attacks on things and network security threaten the IoT ecosystem. In addition to attacks on things during the maintenance phase, there are also physical attacks that target the software of things or the chip inside them. Communication attacks are carried out in the network environment to intercept the data transmitted by the things. The vulnerabilities in the APIs that things use to communicate with each other can be exploited for attacks. In 2016, passengers traveled without paying because 2000 ticket vending machines were shut down in the attack on San Francisco's transit system. The wide range of uses for the Internet of Things means that a variety of systems can be affected by attacks. The 2003 power outage, for example, caused more than $6 billion in damage.

Some of the measures that can be taken to protect the Internet of Things from cyber attacks can be listed as follows;

- Device policies must be established. With these policies, the security of the data contained in the device will be ensured by creating the device password security level or device locking methods.
- Although the passwords used are difficult to guess, two-factor authentication should be used.
- By using next-generation firewalls as hardware or software-based network security systems, unauthorized access to the IoT network can be detected and prevented.

- By performing network segmentation, a possible threat that may occur in the network will be kept in a certain section. IoT devices and other IT devices should be separated from each other in the network environment.
- Security measures must be taken at the chip level.
- It is necessary to keep the software contained in Things up to date.
- Data to be transmitted between Things and to the cloud must be secured by cryptographic methods.
- Isolation measures should be implemented to prevent attacks on the software contained in the Things.

Cybersecurity

Cybersecurity is a discipline that encompasses methods to protect computers, servers, electronic systems, and data from malicious cyber threats. It aims to reduce the risk of cyberattacks on software, computers, and networks. It includes tools for infiltration detection, virus and malicious access defense, mandatory scanning, and encrypted communications (Amoroso, 2006). It is a collection of tools, decisions, security concepts, security measures, policies, risk management approaches, learning processes, and best practices whose goal is to protect the cyber environment and institutional/legal interests (ITU, 2009). It is the state of protection against unauthorized or illegal use of electronic data or a method of taking action to ensure this (Oxford University, 2014). Looking at the definitions, it can be said that the main goal of cybersecurity is to protect against threats that may occur in cyberspace.

With the rise of digital transformation, more and more services are being used by governments, businesses, and legal entities through cyberspace. Any service that is accessible via the Internet is vulnerable to cyberattacks that may come from the outside. This applies not only to corporate servers but also to end-user computers and mobile devices. In the digital environment where all these types of devices are connected, it is important to ensure the reliability of devices and information at the institutional and personal levels.

As a result of the increasing use of information tools, ensuring the security of information and information processing/producing devices is becoming more important every day. In addition to defining cybersecurity, it is important to know the common and different aspects of cybersecurity and information security. Information security ensures the protection of data generated by services and systems from unauthorized access, unauthorized modification, and loss of validity. Cybersecurity and information security both seek to protect data. While cybersecurity provides this protection with its security mechanisms in cyber environments, the environment, and type of access are not important to information security. Moreover, cybersecurity provides protection for data in digital environments, while information security works to protect data in both physical and digital environments.

Actions that damage systems in the cyber environment, disrupt the service process, and affect the reliability of data are perceived as threats. To protect against threats, they must first be identified. While some threats are caused by intentional acts, there may also be threats caused by user error. For example, if the system administrator inadvertently grants access to an unauthorized user, the security of the system and the information it contains is compromised. Cyber threats can be categorized into five levels as their impact is examined. Hacktivism, the least effective cyber threat, can be defined as the misuse of a system for social or political reasons. Although individuals generally pose a threat, there are also groups that have banded together for the same purpose. Cybercrime, which is a more common threat type than hacktivism, can be defined as murder in a digital environment. Cybercriminals use computers for crimes such as obtaining personal data and malicious information. The use of computer networks by hackers to obtain secret information against countries or specific organizations is referred to as cyber sabotage. Cyber terrorism, another type of cyber threat, is an attack on computer systems, computer programs, and important data that relies on infrastructure and is politically motivated (FBI, 2012). Cyber warfare is the most common attack against a country to disrupt critical systems, including public services, to disrupt services, challenge reliability, and damage the country's reputation.

To appreciate the importance of cybersecurity, one must look at global cyberattacks and the losses they have caused. There were 4,145 publicly disclosed breaches that exposed over 22 billion records in 2021. It was reported that 3 billion Yahoo user accounts were hacked in 2016. In the same year, it was revealed that over 57 million drivers' information stored in UBER company's systems were captured by cyber hackers. In 2017, it was found that 412 million Friendfinder website membership accounts were stolen. At the same time, it was reported that 31% of companies worldwide were affected by cyberattacks at least once in 2017. In the same year, nearly 148 million consumers were affected by a security vulnerability called Equifax. According to Symantec's report, nearly 2400 mobile malware were blocked every day in 2017 (Ulutas, 2018). In 2021 March, 533.000.000 records (phone numbers, full names, locations, email addresses) were lost on Facebook. In 2021 September, 500.000.000 records were lost on Syniverse which is a company that is a critical part of the global telecommunications infrastructure used by AT&T, T-Mobile, Verizon, and several others around the world (McCandless et al., 2022).

Rank	Entity	Sector	Records Compromised
1	Yahoo	Web	3.0B
2	River City Media	Web	1.4B
3	Aadhaar	Government	1.1B
4	First American Corporation	Finance	885M
5	Spambot	Web	711M
6	Linkedin	Web	700M
7	Facebook	Tech	533M
8	Yahoo	Web	500M
9	Marriott International	Retail	500M

Figure 3. 10 largest data breaches by the amount of user records stolen from 2004–2021 (Nwosu, 2022)

In today's world, where digital transformation is taking place at the state and corporate level, the processes that are being moved to the cyber environment are increasing day by day. Considering that every service opened in cyberspace contains information that must be protected, it is inevitable to ensure the security of the cyber environment. In recent years, the importance that companies and states attach to cybersecurity and the measures they have taken have become apparent. If you examine job posting websites, you will see that the need for cybersecurity specialists has increased significantly. States, in turn, are making radical policy changes to strengthen their cyber armies and meet the need for cybersecurity experts.

Blockchain

In relation to the increasing data transfer in the Internet environment, the need for a database to store data is increasing day by day. Controls such as updating data, ensuring its integrity, and access permissions are provided by the database management system. The centrality of the database brings new challenges (maintenance, load balancing, uptime, etc.). The term blockchain was first introduced in 1991 with the use of timestamps to prevent the date of digital documents from being changed. Blockchain technology, for which there were no widespread use cases until 2008, came onto the world's agenda with the cryptocurrency Bitcoin, developed by the user nicknamed Satoshi Nakamoto in 2008. In the most general sense, blockchain can be defined as a protocol that enables the sharing of data in a decentralized, distributed network environment without the need for a central authority.

Blockchain is a distributed database structure consisting of the concatenation of blocks without a central point of control. Blocks are boxes that can store limited data. All data has a timestamp. Users in the distributed network have the task of verifying the data contained in the blocks. The chain structure is created by adding the hash value of the data contained in the block whose capacity is full to the next block. This ensures that the data in the blocks contained in the chain does not change. Since changing the data contained in the block or adding new data changes the hash value of the block, tampering with the data can be easily detected. The data contained in the blocks can differ depending on the type of blockchain. While this information may be money transfers for virtual currencies, it may be customer data or product information, depending on the design.

When building the blockchain network, it can be designed as public/permissionless or private/permissioned. The best example of general networks is Bitcoin and other altcoins. There are no restrictions or permissions to access such networks. Anyone can track or process the data contained in the blocks of the blockchain network. In private networks, a node of the blockchain must be approved by the authorized organization that owns the network. Such networks are usually controlled by banks, financial institutions, corporations, or the government.

The most important feature of the blockchain network is its transparency. The fact that there is no central database, that the data is accessible to everyone, and that a certain amount of unverified data is not recorded in the ledger (database) maintains the transparency of the blockchain network. In this way, the system cannot be controlled or shut down by a central authority. In addition to the elimination of intermediary institutions, features such as the encryption of data and the use of digital signatures increase the reliability of the system.

Like any new idea, blockchain has its downsides. With a history of 14 years, a relatively new approach, limited areas of use, vulnerabilities, and cases of theft in bitcoin clearinghouses, confidence in the idea of blockchain is being questioned. The lengthy approval procedures for the data contained in the blocks limit the use of blockchain networks in certain areas (finance, trade). The cryptographic algorithms used in the validation of block data consume a lot of energy due to the computational processes required. Another problem is that due to anonymity, the owner of the data contained in the blocks cannot be precisely determined. The fact that the information pointing to the owner of the data consists only of the user name and the real name and identity information cannot be accessed means that the data in the blockchain network cannot be matched with real people.

Cloud Computing

The 1960s were when the idea of cloud computing first emerged. This idea is a computing paradigm in computing that has evolved to offer computer services. The internet, virtualization, grid computing, web services, etc. all employ this method of computing extensively. It is based on several current technologies, including internet technology adds a new dimension to this service (Mathew, 2012). Numerous studies have been conducted to update the current information infrastructure, especially in the sphere of education, in recent years as educational institutions, universities, and companies have completely contributed to the transformation of society and the global economy.

Despite the increasing importance of cloud computing, several establishments struggle with financing. The ability of cloud computing to update at any time and the instantaneous transmission of transactions to numerous users has given rise to the notion that more money should be spent on web-based cloud systems in information technology. Information technology, as well as many other areas, is particularly damaged by natural disasters, fires, and epidemics. Sectors may not be impacted by such calamities because they use the cloud to conduct their business. But the acquisition of non-public knowledge by hostile actors can lead to a collapse of that company. In this situation, it is necessary to invest in security services, which could result in additional costs. But when you consider everything together, using the cloud to do the work is more favorable in terms of sharing and efficient functioning. In the education sector, as in every other, cloud computing offers a number of benefits. The corporate sector, the public sector, and academics have all decided to work remotely for a period in response to the COVID-19 epidemic, which is a widespread pandemic around the world. Although it was first difficult to offer training on this topic, the issue was quickly resolved with the help of cloud-based tools.

Cloud computing providers offer their services according to four models. Infrastructure service (IaaS) is the most basic, and each rising model leaves fewer jobs for organizations receiving cloud services.

Software as a Service (SaaS)

Users that utilize Software as a Service (SaaS) have access to apps through any platform connected to the Internet without the need for any installation. Examples of SaaS include Google Docs, Yahoo Mail, ERP, BPM, and CRM software. Because service providers may host applications and data, the end-user can use the service from any location (Bhardwaj et al., 2010).

Key features (IBM, 2021);

- SaaS suppliers provide software and applications to users through a subscription model.
- Users do not need to manage, install, or upgrade software; they are managed by SaaS providers.
- Data is safe in the cloud; equipment failures do not cause data loss.
- The use of resources can be scaled according to service requirements.
- Applications can be accessed from almost anywhere in the world from any internet-connected device.

Infrastructure as a Service (IaaS)

The operating system layer is where the company’s management obligation begins, and the provider is in charge of ensuring the dependability and availability of the infrastructure it offers. This paradigm could be useful in some usage circumstances. The Infrastructure-as-a-Service concept appeals to businesses without their own data center as a quick and affordable infrastructure alternative for projects that may be expanded or canceled as necessary (Barabba, 2021). Examples of traditional businesses that use infrastructure as a service well include those that require IT power to manage varied workloads with reduced capital expenses. Companies only pay for the services they utilize in both situations (Barabba, 2021).

Key features (IBM, 2021):

- Users pay for the Infrastructure Offered as a Service to their needs rather than buying hardware.
- The infrastructure may be built up to meet the needs for processing and storage.
- Saves businesses from having to pay for and maintain their own equipment.
- There is not a single point of mistake because the data is on the cloud.
- Management activities can be virtualized to free up time for other jobs.

Platform as a Service (PaaS)

The platform of IAAS is what is intended for more sophisticated and feature-rich targets. PaaS, or platform as a service, is a type of cloud computing service model that gives hardware and software resources to application developers online so they may work on their projects. Servers, storage, network, and PaaS infrastructure (along with development tools, business intelligence services, database administration, system administration, and security solutions) are all examples of the latter. Users that utilize PaaS have access to a cloud environment where they may create, maintain, and distribute applications. Databases, operating systems, and programming languages, among others. It is the top illustration of a PaaS system (Mysoft, 2021).

Key features (IBM, 2021):

- Users pay for the Infrastructure Offered as a Service to their needs rather than acquiring hardware;
- The infrastructure may be scaled up by processing and storage needs.
- Saves businesses from having to pay for and maintain their own equipment.
- There isn’t a single point of mistake because the data is on the cloud.
- Management activities can be virtualized to free up time for other jobs.

Mobile

Mobile technologies used in mobile devices include Wi-Fi, Bluetooth, Wi-Max (Worldwide Interoperability for Microwave Access), LTE (Long Term Evaluation), GSM (Global System for Mobile Communication), GPRS (General Packet Response Service), and 1G, 2G, 3G, 4G, 5G.

The first wireless mobile network generation was established in the 1980s as the first generation, mobile (1G), utilizing analog transmission for speech services by Nippon Telephone and Telegraph (NTT) in Tokyo, Japan, to power the first cell phones, but the technology was limited to delivering speech services between devices, and the transmission functioned analogically and utilized radio signals to encode the audio and this resulted in communication service difficulties (Patel, et al., 2018).

When the first generation of digital connection debuted, it was promptly dubbed “2G,” and the word “1G” was rendered obsolete. 2G is based on GSM (Global System for Mobile Communication) technology and uses GSM and GPRS technologies.

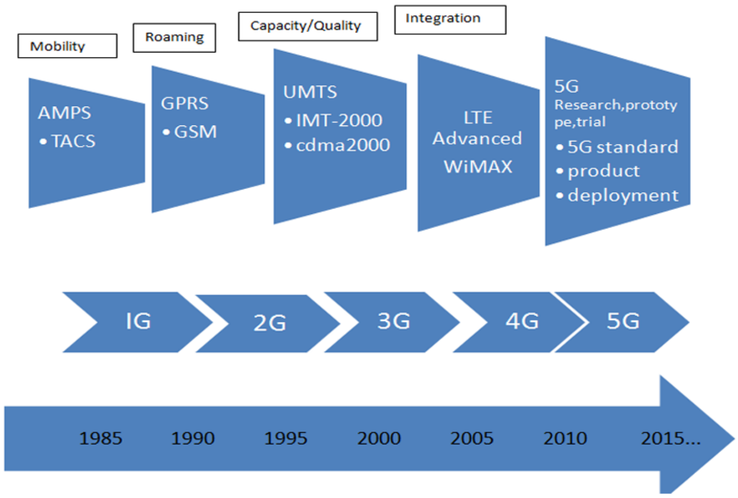

Figure 4. Mobile Cellular Network Evolution Timeline (Sood& Garg, 2014)

Afterward, with 2.75G technology, EDGE (Enhanced Data Rates for Global Evaluation) and EGPRS (Enhanced GPRS) technologies were used. With EDGE, the data transfer rate increases to 236.8 Kbps. EDGE technology may be used in any network that supports GPRS technology and does not require any additional software or hardware. (Ekren & Kesim, 2016). In comparison to EDGE, GPRS can send data in two seconds, but EDGE transmits data in six seconds (Rayan and Krishna, 2014). Then NTT DoCoMo launched 3G in Japan in October 2001. In comparison to previous generations, 3G provided mobile consumers with an exceptional experience by providing high-speed connections (Emmanuel & Marvis, 2014.

3G is made up of a core network and a radio access network. Voice call switching and general packet radio service were the core network functionality systems (GPRS) because 3G RAN deviates from basic functionality, mobile devices, and network terminals can access the network independently (Ezhilarasan & Dinakaran, 2017). The smartphone had achieved its pinnacle by the time 3G was released because of connection, internet-ready apps were being developed at a rapid pace, and phones were transformed into portable minicomputers with the debut of 4G technology, the first phones with backward compatibility were created (Burkhalter, 2021). 4G, or fourth-generation wireless communication technology, seeks to provide faster speeds and a better user experience than 3G, the previous generation wireless connection technology. 4G internet speeds may reach up to 100 Mbps, allowing users to experience high-speed applications such as online gaming, high-definition video streaming, and interactive TV (Patel, Shah, and Kansara, 2018). IEEE’s LTE/LTE-A and mobile WiMAX 2.0 (802.16m) technologies are considered 4G technologies (https://www.btk.gov.tr/4-5g-nedir, 18.12.2017)5G aims to do more than just increase speed; it will also establish a wireless link to other devices. The outcomes are expected for home usage, with the growth of the notion of connected dwellings, and for industrial services, with new automation and Internet of Things possibilities (IoT) (Brockway, 2021). Many nations are still in the testing phase of 5G adoption, which entails a series of phases, and Apple’s first compatible model, the iPhone 12, will be introduced in 2020. In addition, compatible phones have been released in recent years by Samsung, Motorola, Realme, and Huawei (Brockway, 2021).

Table 2. Comparative Study of various Wireless Generations (Sood & Garg, 2014)

1G	2G/2.5G	3G	4G	5G
Start/Deployment				
1970/1984	1980/1999	1990/2002	2000/2010	2000/2015-2020
Features				
-Make use of analog radio signals **Services:** Analog voice service. No data service	-Used Digital radio signals -Voice encoded to digital signals **GSM:** Supported digital voice service, SMS messaging, improved voice clarity.Comparatively secure **GPRS:** Supported MMS, İnternet Comm.	Fast data transfer rate, Improved spectral efficiency, and greater network capacity. **Services:** Enhanced audio video streaming video conferencing support, Web browsing at higher speeds, IPTV support	-Converged data and voice over IP -Entirely packet-switched network, -Higher bandwidth to provide multimedia services at a lower cost (up to 1000Mbps) **Services:** Enhanced audio, video streaming, IP telephony, HD mobile TV	-Simultaneous access to different wireless technologies -complete wireless communication (Wireless world wide web, WWWW) **Services** -Dynamic information access -Wearable devices with AI capabilities
Data rates				
2kbps	14.4-6.4kbps	2Mbps	200 Mbps to 1 Gps	1Gbps and higher
Standards				
MTS, AMTS,IMTS	2G: GSM 2.5: GPRS 2.75: EDGE	IMT-2000 3.5G-HSDPA 3.75G: HSUPA	Single unified standard LTE, LTE adv Mobile WİMAX	Single unified standard
WEB Standard				
--------	www	www (IPv4)	www (IPv4)	www (IPv6)
Technology				
Analog cellular technology **Throughput** 14.4 Kbps	Digital narrow band circuit data, Packet data **Throughput** 20-20Kbps	Digital Broadband Packet data **Throughput** 3G:200Kbps 3.5g: 1-3 Mbps	Digital Broadband Packet All, Very high throughput **Throughput** 100-300Mbp	Proposed: Unified IP and seamless combination of broadband, Local area networks, Wide area networks, personal area networks, Wireless LAN
Service				
Mobile telephony (voice)	2G: Digital voice, SMS 2.5: Higher capacity packetized	Integrated high quality audio, video, and data	Dynamic informations access, wearable devices with AI capabilities	
Technology				
Analog wireless cellular technology used	Digital wireless network used	Digital broadband network	Digital broadband packet	Proposed: unified IP and seamless
Switching				

Circuit	2G: Circuit 2.5G: Circuit for access network & air interface; Packet for care network	Packet except circuit for air interface		Packet switching Message switching
Handoff				
Horizontal only	Horizontal only	Horizontal & Vertical		
Shortfalls				
Low capacity, Unreliable handoff Poor voice links, Less secure	Digital signals were reliant on locations & proximity, required strong digital signals to help mobile phones	Need to accommodate higher network capacity	Being deployed	Yet to be implemented

Wi-Fi

The technology is known as "wi-fi," which stands for "wireless internet," and is the sine qua non of modern existence. Wireless internet technology is not limited to "Wi-Fi." When connecting to the wireless internet, you can utilize systems such as 3G, 4G, and LTE. However, in terms of speed, ease, safety, and ongoing usage, "wi-fi" outperforms these technologies.

Wi-fi is a wireless network technology that uses radio waves to accomplish two-way communication, and numerous devices may be linked to a single wireless network at the same time since devices that use this technology support the frequency range between 2.4GHz and 5GHz (Ekren & Kesim, 2016).

Bluetooth

Bluetooth is a technology that allows for the quick and easy communication of data and audio between devices without the use of cables or connecting equipment (Bisdikian, C,2001). The demand to transport data without using cables between personal devices, home, industrial devices, and business devices is growing by the day. Bluetooth, on the other hand, stands out as a technology that is quick, dependable, and affordable, and that all devices can interact with ease.

Wi-Max

WiMax, like wifi and LTE, is an IP-based wireless technology designed to offer a continuous connection between the user and the base station across a vast area at a radius of 3-10 km, regardless of the field of vision. LTE, on the other hand, is a high-speed wireless data transfer standard that employs GSM and GPRS technology.(Wikipedia-LTE). Speeds increased to 0.1 Mbps with 2G, and numerous users may connect to a single, secure channel. The introduction of 3G, which elevated mobile networks and data usage to unprecedented heights, was a true game-changer. Speeds increased to 2 Mbps, and the 3G network was expanded with towers that could serve 60–100 people simultaneously without experiencing any service disruption. Every moment a technological advancement was achieved, the first three tiers of connectivity needed new hardware.

Discussion and Conclusion

In today's world, constantly developing technology makes the change and transformation of organizations inevitable. This development creates data piles all over the world. The processing and interpretation of data, which is the rawest form of information, is of great importance for organizations. The information obtained by processing raw data with technological devices and in a rational way is seen as the raw material of transformation in the digital age. In organizations where competition and change come to the fore, future planning, rational decision-making and efficiency goals reveal the need for information systems and information technologies (Barnet & Cavanagh, 1995). Information systems that enable the processing, interpretation and reporting of data, and fixed and mobile technologies that provide remote access to information constitute the first wave of digitalization. Afterward, the second wave of digitization is connected to the internet and internet platforms. The third wave of digitization, which includes advanced technologies such as IoT, AI and Big Data, aims to process information and create an effective decision process (Katz, 2017). In the digital transformation process, which expresses holistic transformation far beyond digitalization with digitalization, everything can be measured and supported by various methods, techniques and technologies (Altuntas, 2018).

These technologies are used to increase the efficiency of decision processes, increase the speed of information processing, detect patterns, effectively manage customer relations, and determine needs and requirements. In this section, technologies that shape digital transformation are mentioned. Based on these technologies, it can be said that all technological developments started with digitalization and then each development triggered the next development. These developments have made change and transformation inevitable in different fields. Digital transformation consists of redesigning and transforming existing processes in the context of human, processes, and technology in line with new developments, taking into account new technologies. This process is of great importance for organizations to achieve their long-term goals. Digital transformation, implemented in line with the needs and requirements of individuals, businesses, and organizations, increases competitive advantage by ensuring success.

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CHAPTER

Digital Transformation and Productivity: A Bibliometric Analysis

3

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Digital Transformation and Productivity: A Bibliometric Analysis

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Introduction

World history is shaped by transformations triggered by technological developments. The process we are going through is called Industry 4.0 or the fourth industrial revolution. Germany's new industrial breakthrough emerged at the Hannover fair in 2011 and gained popularity with the concept of "industry 4.0" (Krykavskyy et al., 2019). The concept of Industry 4.0 is named differently in various countries. For example, the concept is called "advanced manufacturing partnership" in the USA, "the future of manufacturing" in the UK, "the future of factories" in the European Commission, "innovation in production 3.0" in South Korea, and "made in China 2025" in China (Liao et al., 2017). This process necessitates a digital transformation in almost every aspect of life (Frederick, 2016). Digital transformation (DT) aims to restructure the organization's processes by applying digital technology to achieve benefits such as greater productivity, cost savings, and innovation. This transformation, which includes the human mind at the top and includes many technologies such as the internet of things, cloud computing, blockchain, big data, and artificial intelligence, brings radical changes in business processes and social life. In addition to being more prominent in the production sector, digital transformation also affects other economic areas such as health and education. Thanks to digital transformation, a doctor can quickly review the x-rays and inform his patient in another country. In addition, students can choose courses from various universities with distance education, receive education on their own interests, and access information quickly. Day by day, individuals and companies adopt the technology by asking 'how can I be more productive?', and aim to increase productivity thanks to advanced technologies. Due to the diversity of digital technologies and their applications, digital transformation is present in almost every field such as healthcare, education, manufacturing, retail, automotive, mining, and telecommunications (Lerch et al., 2015; Rachinger et al., 2019). Therefore, there has been a significant increase in the number of academic research on digital transformation. In the past, many literature review studies have been conducted in the field of DT (Chawla & Goyal, 2021; Cortes-Sanchez, 2019). However, it is noteworthy that there are not enough studies on digital transformation and productivity. This study aims to fill this gap by summarizing productivity-related documents in the digital transformation literature using the bibliometric analysis technique. Bibliometric analysis is the numerical analysis of publications produced by individuals or institutions in a certain area, period, and region, and the relations between these publications (Martinez-Lopez et al., 2018; Saha et al., 2020). Revealing the general situation of the current field requires identifying the popular keywords, prominent authors, studies, publishers, organizations, and countries in the field of digital transformation and productivity.

Therefore, answers to the following questions are sought.

RQ1. What is the contribution of digital transformation and productivity studies to the field?

RQ2. What are the popular keywords standing out in the field, and which keywords have come to the fore recently?

RQ3. What are the prominent authors, studies, and publications?

RQ4. What are the prominent organizations?

RQ5. What are the prominent countries and what is the status of co-authorship between countries?

Method

The bibliometric analysis summarizes published information through quantitative statistics, including the rank of most productive researchers, the geographic distribution of authors, the rank of most productive institutions, the number of publications and citation growth, etc. In addition, it is a research method that includes techniques based on the measurement of processes and features related to documents (Thelwall, 2008). The data of this study was taken from the Scopus database. The Scopus database includes more than 5000 publishers worldwide, including Elsevier, Emerald, IEEE, Sage, Springer, Taylor & Francis, and Wiley Blackwell (Gurcan et al., 2021). A scan sequence was used to obtain the data. The terms ((“digital transformation” OR “digitalization” OR “digitalisation” OR “digital enabler”) AND (“productivity” OR “productiveness”)) were searched in Scopus database within the research titles, abstracts, and keywords. For the analysis, the studies between the years 2011-2021 were searched without index and year limit. Only published studies were considered in the filtering process. Filtering processes resulted in 697 studies.

The data set including the publication year, title, author name, publisher number of citations, and keywords of the study was analyzed through VOSviewer. This software was used for the analysis and creation of maps using VOS clustering and mapping methods. Cobo et al., (2015) found that VOSviewer and Cite Space software are frequently used in the comparison of various visualization tools for scientific mapping. VOSviewer is a relatively easy-to-use tool that provides the basic functions needed to visualize the bibliometric network (Van Eck & Waltman, 2010).

Keyword association and citation analyzes were performed using the meta-data set. A threshold value was used to create more meaningful maps. Co-occurrence analysis of keywords reveals the evolution of the research field over time (Zhao, 2017). Citation analysis provides important data to identify interdisciplinary similarities and differences between prominent publications, journals, and authors (Wohlin, 2008). Performing citation-based analyzes in a field helps to recognize important developments in a discipline or a scientific field. These analyzes provide the historical perspective of scientific progress and help define the main actors of a scientific field (Heradio et al., 2016). The findings of the analysis are presented as maps, figures, and tables.

Findings

General Descriptive Statistics

Figure 1 presents the distribution of digital transformation and productivity studies by citation/year and publication year. The blue columns show the number of publications and the orange line the citations. When Figure 1 is examined shows that the studies are increasing and they are cited more than in the previous year. In addition, digital transformation and productivity studies are mostly published in the fields of "Engineering", "Computer Sciences", and "Business, Management, and Accounting", respectively.

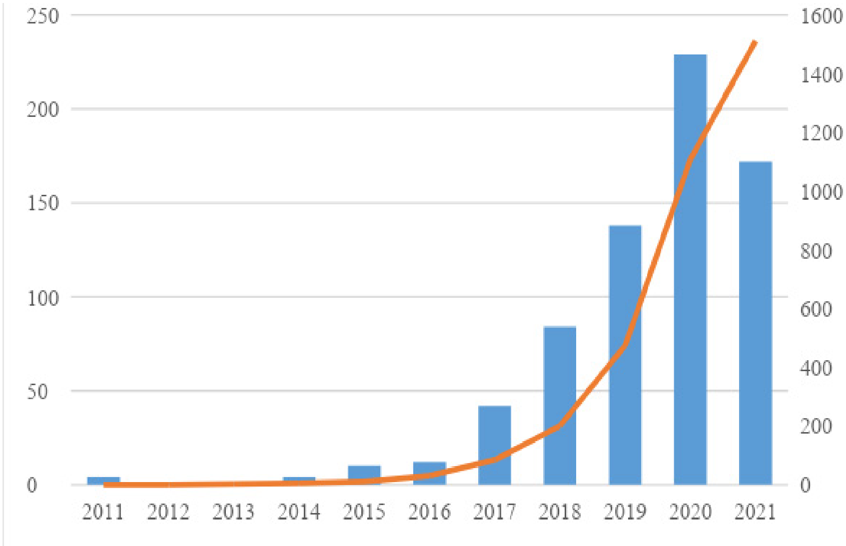

Figure 1. Number of Publications and Citations

Bibliometric Analysis

Keyword Analysis

A total of 2001 keywords were used in the data set that consists of 697 publications. The keywords used in the query are excluded. Co-occurrence analysis was performed with keywords that were repeated at least 5 times. A total of 58 keywords that meet this criterion formed seven different clusters as seen in Figure 2.

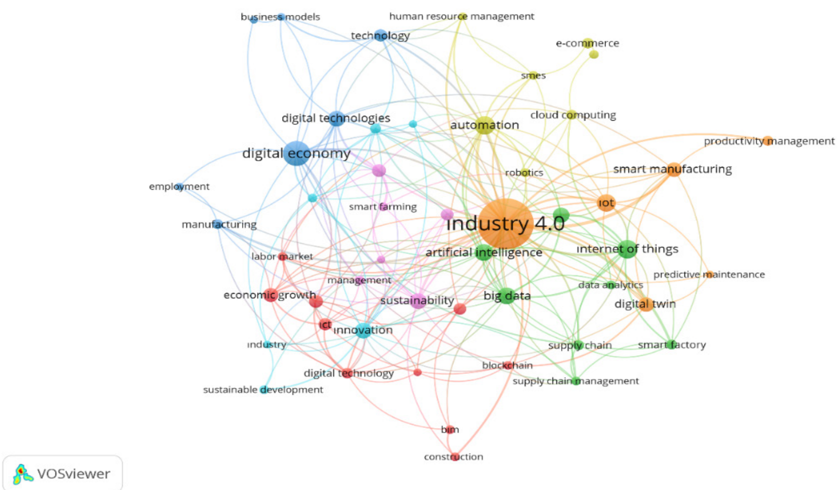

Figure 2. Keyword co-occurrence map

As seen in the co-occurrence network visualization map in Figure 3, these keyword clusters provide an idea of common topic links in research. The red cluster is the largest. The most repeated keywords are blockchain, economic growth, digital technology, labor productivity, labor market, competitiveness, structure, human capital, information and communication technology (ICT), and building information modeling (BIM).

The most repeated keywords in the second green cluster are artificial intelligence, machine learning, and the internet of things, big data, smart factory, data analytics, supply chain, and supply chain management. The most frequently repeated keywords in the third (blue) cluster are business models, business, manufacturing, e-government, technology, digital technologies, and digital economy.

The most used words in the fourth (yellow) cluster are automation, robotics, cloud computing, covid-19, e-commerce, human resources management, and SMEs. The most repeated keywords in the purple cluster are management, knowledge management, sustainability, augmented reality, agriculture, and smart agriculture. Industry, innovation, transformation, performance, sustainable development, and information technologies are the most repeated keywords in the sixth cluster (turquoise). Finally, the seventh cluster (in orange) highlights the keywords industry 4.0, predictive maintenance, productivity management, and smart manufacturing. It is clear in Figure 3 that the clusters converge and the circles are close together, indicating that researchers in related clusters are more likely to cite similar situations. Trending research topics by year can be identified from an overlay visualization map of keywords (Figure 3).

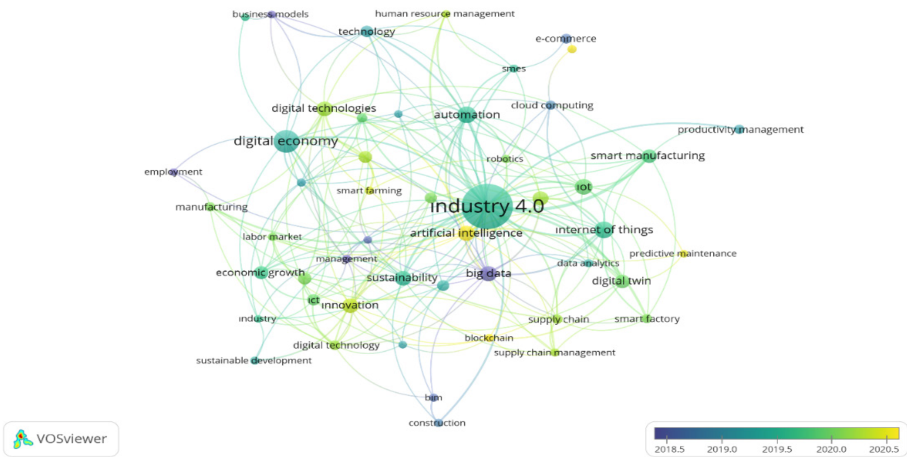

Figure 3. Overlay visualization map of keywords by year

According to Figure 4, the trends in digital transformation and productivity studies are shifting towards topics such as artificial intelligence, blockchain, covid-19, and predictive maintenance. These findings show that these issues have attracted researchers in recent years.

Citation Analysis

Citation analysis involved 1990 authors who contributed significantly to the field. Table 1 summarizes the authors who contributed to this field with at least three documents.

Table 1. Prominent authors

Rank	Author	Documents	Citations
1	Jeske, Tim	8	21
2	Weber, Marc-André	8	19
3	Lennings, Frank	7	21
4	Stowasser, Sascha	6	19
5	Bauer, Wilhelm	3	99
6	Carlsson, Christer	3	18
7	Sharma, Sumita	3	39
8	Skoogh, Anders	3	48
9	Subramaniyan, Mukund	3	48
10	Würfels, Marlene	3	13

According to Table 3, Tim Jeske and Marc-André Weber stand out as the authors with the most publications. Other prominent authors are Frank Lennings, Sascha Stowasser and Wilhelm Bauer. In addition, citation analysis was performed on the documents obtained to discover the most influential publications in the digital transformation and productivity field. Table 2 shows the 11 most contributing studies. These studies have been cited 50 or more times.

Table 2. Prominent publications

Authors/ Year	Research Title	Publisher	Citations
Dimitrov, 2016	Medical internet of things and big data in healthcare	Healthcare Informatics Research	350
Nagy et al., 2018	The role and impact of industry 4.0 and the internet of things on the business strategy of the value chain-the case of Hungary	Sustainability (Switzerland)	149
White, 2012	Digital workplaces: Vision and reality	Business Information Review	97
Bauer et al., 2015	Transforming to a Hyper-connected Society and Economy – Towards an "Industry 4.0"	Procedia Manufacturing	95
Kah et al., 2013	Advanced gas metal arc welding processes	International Journal of Advanced Manufacturing Technology	89
Li et al., 2019	Blockchain in the built environment and construction industry: A systematic review, conceptual models and practical use cases	Automation in Construction	81
Mechtcherine et al., 2019	Large-scale digital concrete construction – CONPrint3D concept for on-site, monolithic 3D-printing	Automation in Construction	68
Evangelista et al., 2014	The economic impact of digital technologies in Europe	Economics of Innovation and New Technology	63
Abad-Segura et al., 2020	Sustainable management of digital transformation in higher education: Global research trends	Sustainability (Switzerland)	55
Heilig et al., 2017	Digital transformation in maritime ports: analysis and a game theoretic framework	NETNOMICS: Economic Research and Electronic Networking	53
Kim, 2020	The Impact of COVID-19 on Consumers: Preparing for Digital Sales	IEEE Engineering Management Review	51

As seen in Table 2, the research conducted by Dimitrov (2016) draws attention as the most popular article with the highest number of citations (350). His article focuses on the internet of medical objects and big data in the healthcare field. It also highlights the importance of the application of wearable devices and mobile technologies in the field of health. In another study by Heilig et al. (2017), the authors presented an overview of the development and current state of digital transformation in modern seaports to identify current potentials and barriers. Greenwood & Kassem (2019) revealed the adoption of blockchain technology in the construction industry, which is one of the components of digital transformation, and the current state of the construction industry. Abad-Segura et al. (2020) investigated research trends in terms of sustainable management of digital transformation in higher education. The research conducted by White (2012) investigated how the digital workplace perceptions of employees in businesses changed over time and the reasons that made it a critical strategic direction for businesses. They also claimed that necessary elements of the digital workplace could be realized by combining applications based on mobile, big data, cloud computing, and searching. Evangelista et al. (2014) examined the economic impacts of digital technology in Europe by distinguishing between different aspects of the digitalization process. Another important study conducted by Nagy et al. (2018) examined how businesses in Hungary interpret the Industry 4.0 paradigm, in which processes they use the Internet of Things (IoT) tools, and what critical problems they encounter in the adoption of Industry 4.0. They used the value chain model proposed by Porter (1985) to examine the impact of Industry 4.0 on businesses. Kim (2020) has extensively analyzed the impact of digital transformation on productivity and corporate culture during the Covid-19 process. Citation analysis was conducted to determine the publishers of publications that contributed to this area. Many publications have contributed to the field of digital transformation and productivity, demonstrating how popular the topic is in the literature. 19 of 434 publishers published at least 5 studies in this field. The 10 most cited publishers on digital transformation and productivity are reported in Table 3.

Table 3. Prominent publishers

Rank	Publisher	Documents	Citations
1	Sustainability (Switzerland)	20	389
2	Procedia Manufacturing	13	169
3	Advances in Intelligent Systems and Computing	22	59
4	Procedia CIRP	6	46
5	Procedia Computer Science	6	35
6	International Journal of Environmental Research and Public Health	6	35
7	Lecture Notes in Business Information Processing	5	24
8	IOP Conference Series: Earth and Environmental Science	14	20
9	Lecture Notes in Computer Science	5	17
10	E3S Web of Conferences	13	14

In addition, citation analysis was conducted to identify the institutions that contributed the most. Digital transformation and productivity studies are carried out in 1169 institutions around the world. The Plekhanov Russian University of Economics and the State University of Management are top-performing institutions in this field of study (Table 4).

Table 4. Prominent organizations

Rank	Organisation	Country	Documents	Citations
1	Plekhanov Russian University of Economics	Russian	5	8
2	State University of Management	Russian	5	5
3	University of Almeria	Spain	4	140
4	Chalmers University of Technology	Sweden	4	68
5	Financial University	Russian	4	2
6	Kiel University of Applied Sciences	Germany	3	5
7	Samara State University of Economics	Russian	3	3
8	Institute for Advanced Management Systems Research (IAMSR)	Finland	2	18
9	Crowdsourcing Week	USA	2	13
10	Nizhny Novgorod State Engineering and Economic University	Russian	2	6

100 countries contribute to digital transformation and productivity studies. Table 5 shows the 12 most influential countries with at least 15 studies. Russia stands out as the country that publishes the most documents on the field. Russia is followed by Germany, the USA, India, and England, respectively.

Table 5. Prominent countries

Rank	Country	Documents	Citations
1	Russian Federation	124	204
2	Germany	96	598
3	United States	44	319
4	India	39	107
5	United Kingdom	33	311
6	Finland	27	183
7	Italy	27	237
8	China	26	127
9	Spain	23	164
10	Malaysia	17	85
11	Sweden	16	113
12	Türkiye	15	39

Figure 5 shows the co-authorship network of countries with at least five studies (36 countries) according to the co-authorship analysis by country. Collaboration clusters are represented by colors. It means that countries represented by the same color cooperate more than countries in other clusters. The size of each circle indicates the number of publications in countries. For example, Russia has the widest circle as it contributes more in terms of publications. The co-authoring link is indicated by lines. A thick line between any two countries shows that there is a lot of co-authorship.

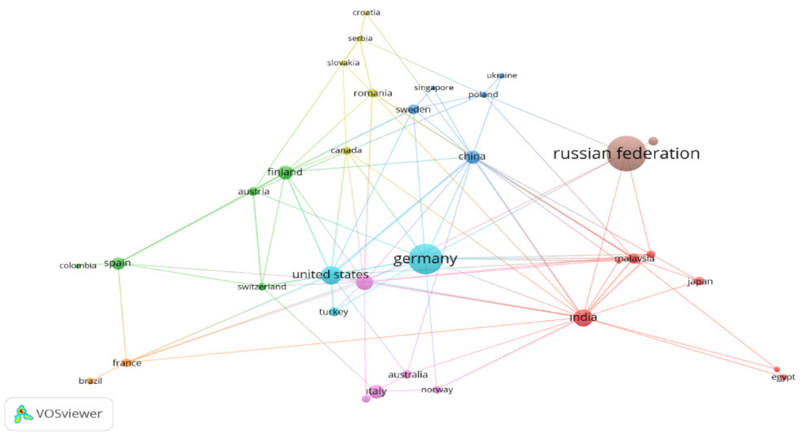

Figure 4. Country co-authorship in digital transformation and productivity

In Figure 4, India and Malaysia stand out in the red cluster with the most cooperation among countries. In the green cluster, China is ahead of Finland and Sweden in terms of cooperation. Canada and Romania are at the forefront of the cooperation formed in the blue cluster. In addition, the United Kingdom and Italy in the yellow cluster, Spain in the purple cluster, Germany, the USA, and Türkiye in the turquoise cluster, Brazil and France in the orange cluster, and Russia and South Africa in the brown cluster form co-operation clusters. Only 2 of these 36 countries (Kazakhstan and South Korea) have no cooperation with other countries.

Discussion and Conclusion

This study aimed to reveal influential authors, studies, publishers, organizations, and trending topics by using a metadata set of published research in the field of digital transformation and productivity. 697 studies obtained from the Scopus database were analyzed. Since the Industry 4.0 paradigm emerged in Germany in 2011, this study focused on digital transformation and productivity studies published between 2011-2021. The distribution of studies by year shows that there is a continuous increase in the number of publications. There has been a big leap in the field since 2017 and this increase is continuing as of October 2021. In addition, the slope line shows that the publications are gradually increasing. According to the co-occurrence analysis of the keywords, prominent keywords were "industry 4.0", "artificial intelligence", "big data", "internet of things", "digital economy", "smart manufacturing", "innovation", "economic growth", "digital twin" , "digital technologies", and "sustainability". This is an important finding in terms of determining the research topics that form the basis of the field of DT and productivity and the trend research topics in the field. The most used keyword in the field of DT and productivity is "industry 4.0". It is not surprising that this keyword ranks first. The fourth industrial revolution was initially considered a digital revolution in manufacturing. However, today it is defined as the digital transformation of the entire industrial value chain (Culot et al., 2020). Digital transformation within the scope of Industry 4.0 refers to the application of certain digital technologies (Indri et al., 2018). It is noteworthy that the concepts of "internet of things", "big data", "digital twin", and "smart manufacturing" come to the fore in the findings because the driving force of the fourth industrial revolution is digitalization, and the technologies that will make this possible have existed for a long time and have application examples. They are also technologies where new developments are experienced and advanced targets exist.

The internet of things, which is at the forefront of the basic technologies of digital transformation, is based on the principle that the object with sensors that measure or detect certain situations constantly transmits information and takes an action by evaluating this information. Big data aims to evaluate data obtained from different sources such as corporate and customer-based management systems and to standardize real-time decision-making processes. Data, in particular, is considered as the oil of our age and it is a known fact that it is very valuable. If you have data, it gives you the chance to write, test, and verify algorithms. You can generate information using data and then convert it into value. You can make periodic behavioral analyzes of the data and make predictions for the future, so you can come up with a new product idea or create a new market possibility or customer profile. The ultimate goal in the world that digital transformation will create is for every object to have a "digital twin" that is exactly like its structure in the real world. Thus, many scenarios can be simulated in the virtual world. In fact, while a product you put on the market is used by your customer, it can also be experienced in the virtual world with the help of real data coming from the field. Industry 4.0 systems make processes more sustainably efficient. It eliminates repetitive work with automation, embraces human nature, and satisfies employees with more innovative and productive work. Good production planning, standardized work, and expanded productivity reduce the number of people required to complete a task. Managing has been made much less demanding. It eliminates the unnecessary workload of people, creating free time to improve their skills and implement new systems. Digitizing traditional manual-based processes and eliminating waste from production and warehouse operations improves productivity. Increased productivity saves money. This money can be invested in product development to create innovative products of higher quality. Much of the waste comes from overproduction, over processing, defects, and waiting. Elimination of waste with production execution systems, quality management systems, and warehouse management systems ensures increased productivity. Recently, prominent keywords have been "artificial intelligence", "blockchain", and "Covid-19". Artificial intelligence and Blockchain stand out as the main technologies of digital transformation. Artificial intelligence enables the fulfillment of tasks performed by humans. In other words, artificial intelligence makes the computer think like humans. The working principle of artificial intelligence is to combine large amounts of data with fast, repetitive processes and smart algorithms, allowing the software to learn automatically from the patterns or features of the data. Blockchain technology, on the other hand, is a technology by which security is maximized by keeping the data in defined users connected to the network instead of a central location as in traditional databases and making it mathematically impossible to change these records. It is not surprising that the term COVID-19 has recently become a popular topic in studies on digital transformation. Soon after the spread of work-at-home with the COVID-19 outbreak, managers realized that they could rely on technology to minimize the impact of the outbreak on their organizations and operations because it has become a necessity, not a choice, to move a significant part of the work to the online environment for the current processes to continue without any interruption and for all stakeholders to work together without communication problems. Therefore, many companies that stopped or suspended their physical operations during the outbreak had to start their late digital transformation.

This study determined that Tim Jeske and Marc-André Weber are the authors with the most publications in the field of DT and productivity and their contributions to the field continue. The most cited authors are Wilhelm Bauer (99), Anders Skoogh (48) and Mukund Subramaniyan (48).

Tim Jeske is a contributing author at the IFAA Institute for Applied Industrial Engineering and Ergonomics. He is recognized for his research contributions in the fields of Industry 4.0, digitization, and production/process optimization. In addition, he continues to contribute to the literature with his research titled "Development of Digitalization in Production Industry - Impact on Productivity, Management and Human Work" published in 2021. In addition, Marc-André Weber, Professor in the Department of Management Studies at the University of Applied Sciences of Kiel, stands out with his eight studies. He published studies in the fields of factory planning, production systems, lean management, quality management, and industry 4.0. He continues to contribute to the field with his research titled "Human-Robot-Collaboration in the Context of Productivity Development and the Challenges of Its Implementation: A Case Study" published in 2020.

The most influential studies were identified by citation analysis. Studies have generally focused on the application of industry 4.0 components in healthcare sectors, as well as the advantages of DT to institutions. Dimitrov (2016) examined the use of the internet of things (IoT) and big data in the field of health in the most cited article titled "Medical internet of things and big data in healthcare" published in the Healthcare Informatics Research Journal. The article titled "Blockchain in the built environment and construction industry: A systematic review, conceptual models and practical use cases" published by Li et al. (2019) in Automation in Construction journal is one of the top 10 publications and has attracted attention recently. The author identifies recent challenges facing the construction industry and introduces current attempts to explore blockchain as part of the solution to some of these challenges. The fact that a study on Blockchain is in the top 10 points to the emergence of new technologies in the field and therefore the importance of studies on emerging new concepts. Businesses have become tend to digital transformation with the emergence of the covid-19 case affecting daily life. Kim (2020) examined the impact of digital transformation in businesses on productivity and corporate culture. It is important for new researchers in the field to use the articles in Table 2, especially in their theses or other studies, to establish the theoretical framework for DT.

According to the citation analysis conducted to determine the most influential publications, Sustainability was the journal that stood out in terms of citation count. In addition, Advances in Intelligent Systems and Computing is the journal that publishes the most research. The number of studies published by a particular publisher and the citations it receives show the influence of the most productive publisher (Dzikowski, 2018). Overall, these findings indicate that most of the current research in the field of DT has been published in specialized journals. Therefore, it can be said that they will continue to be important journals for the dissemination of DT and productivity research in the next few years. Specialist journals play an important role in the development of the research field, as they provide a way for the dissemination of professional knowledge, encourage the exchange of ideas among researchers, and contribute to the formation of a community of scientific experts in this field (Vanderstraeten et al., 2016). Citation analysis was conducted to identify the institutions that contributed the most to DT and productivity research. The number of documents published by the institution and the citations received by the institution shows the most efficient institution effect (Dzikowski, 2018). Out of 1169 institutions, only 7 have more than three published documents leading DT and productivity research field. According to the number of citations, the University of Almeria ranks first with 140 citations. Similarly, in the ranking of institutions that have published the highest number of articles, the Plekhanov Russian University of Economics and the State University of Management are in the top 2 publishers with eight articles published.

The countries that contributed the most to DT and productivity research were determined by citation analysis and thus co-authorship between countries was determined. Only 12 out of 100 countries published more than 15 articles. According to the total citations received, Germany stands out as the most productive and contributing country. Considering the total number of publications, Russia comes to the fore. Germany, America, England, Italy, and Russia are the leading countries in studies on DT and productivity. Industry 4.0 is the name of Germany's state strategy for digital transformation. Therefore, the German government contributes more to the field due to the funds they provide to researchers. Analysis of co-authorship by country revealed that research in DT and productivity reflects cross-country collaboration. It has been concluded that the most influential countries in this respect are Russia, Germany, and the USA. There is also a strong co-authorship relationship between China and the USA. Türkiye is in the turquoise cluster. On the other hand, Türkiye has a co-authorship relationship with Germany and the USA.

This study used only the Scopus database to obtain data. This is the main limitation of the study. In addition, another limitation of the study is the use of only the above-mentioned keywords in obtaining scientific publications on digital transformation and productivity. Researchers can reach different results by using different databases by changing the research criteria.

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CHAPTER

Digital Transformation from Data Mining to Big Data and Its Effects on Productivity

4

Serkan SAVAS

Digital Transformation from Data Mining to Big Data and Its Effects on Productivity

Serkan SAVAS

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Introduction

Along with the developments in science and technology, there have been periodic changes and transformations in working life and social life. The last of these transformations so far is the digital transformation brought about by information and communication technologies (ICT). With the widespread use of ICT, digital transformation is experienced in every field such as production, industry, education, health, service sector, defence, shelter, nutrition, agriculture, social life, etc.

Depending on the "input-output" relationship within the working logic of digital technologies, data has begun to be produced in exponentially increasing amounts in all fields. When these data are processed in line with their purpose, they are a treasure for institutions. Data mining and big data techniques are of great importance in reaching this treasure. Thanks to the methods and techniques applied in the stages of accessing information from raw data, information management, and information-based decisions have become possible. The advantages of making decisions based on data/information, especially for institutions, are increasing.

Together with automation technologies, the realisation of works that require muscle power by machines, thanks to digital transformation, direct people to work in qualified jobs, thus ensuring efficiency in human resources. It brings many other benefits such as energy-saving, time-saving, resource-saving, etc. In a study, 34% of respondents who started digital transformation initiatives stated that they started to achieve tangible business results such as increased revenue or improved customer relations. Indicating that the sector with the most functional results from digital transformation initiatives in business processes is marketing, the participant managers stated that 74% of the digital initiatives in this field are in the implementation phase, and 41% have started to get results (Altuntas, 2018).

In the literature, the contribution of digital transformation applications to institutions and productivity in different fields has been researched and the importance of using data effectively and efficiently has been mentioned. In the research stating that the digital transformation in industry and production is carried out through the Industry 4.0 perspective, motivation, financing, infrastructure, and working environment are mentioned as the main elements of this transformation. Gulseren and Sagbas (2019) stated that digital transformation is an absolute necessity to overcome the efficiency and investment bottleneck when the current situation of the industrial sector in the world is evaluated. In addition, they also stated that it is a necessity in terms of productivity, growth, employment, and investment potential for the integration of digital technologies into traditional production models on the axis of national development.

Another area where the effects of digital transformation are experienced can be considered as marketing. In fact, this transformation process has also revealed the concept of digital marketing. Miklosik and Evans (2020) extensively investigated the effects of big data and machine learning on marketing. They mentioned that the data, which is increasing exponentially in marketing and the majority of which consists of unstructured data, can be processed by businesses with big data and machine learning. Sagtas (2021) stated in a study that the digital marketing process allows an increase in sales as it can reach a wider audience than traditional marketing methods. In addition, although online sales allow businesses to make transactions more easily since it is different from traditional sales, it is necessary to pay attention to product quality. Because the digital marketing process is one of the components that directly affect the productivity of businesses. Bayuk and Demir (2019) stated that businesses should determine the needs of the customer or the target audience and create marketing activities that will meet these needs. In addition to all these, they stated that the digital transformation experienced by artificial intelligence plays an important role not only in marketing but also in all other business processes, product development activities, data analysis, and all other related areas. Making use of these opportunities and contributing to operational efficiency has now become a necessity. Baltaci (2021) stated in his study that the Covid-19 global epidemic reinforced shopping habits such as contactless shopping and online shopping in human life and that people will continue these habits from now on. For this reason, he talked about the digital transformation process and strategic digital marketing practices that businesses should apply to respond to consumer demands and needs in digital marketing.

Digital transformation in health is the only opportunity for both patients to receive a faster and more quality service in the processes of treatment and diagnosis and for healthcare organisations to work more efficiently (Aslan & Guzel, 2019). Successful implementation of digital health programs is imperative as it is becoming increasingly clear that digital solutions will underpin modern health care (Dendere et al., 2021). Thanks to the algorithms and techniques used in disciplines such as machine learning and deep learning, data analysis, and data-based decisions have become more common. Digital transformation with decision support systems increases the efficiency of doctors and hospitals, contributes to the treatment of patients, and accelerates pre-disease prevention studies. There are application examples of digital transformation in education in many different countries. In a study, Savas (2021) included the stages and strategies of digital transformation carried out in Türkiye within the framework of artificial intelligence. Mikheev et al. (2021), on the other hand, mentioned current trends in the digital transformation of higher education institutions in Russia. Spires (2017) mentioned the digital transformation and innovation studies in education in China, while Mhlanga and Moloi (2020) talked about the studies carried out in South Africa. In all these studies, it is seen that digital technologies are used in all elements in the field of education such as educational tools, teaching methods and techniques, measurement and evaluation processes, career guidance, etc. From this, it can be deduced that the world is changing with the development of technology, and with it, the diversity of education and training activities and the way of implementation have changed. However, since students' learning habits change, teachers should also improve their teaching habits. It is necessary to increase the competencies of the people who will use digital applications and those who will transfer data to these applications in the use of ICT. Teachers, who are the main actors of the teaching processes, also need to use digital technologies effectively in order to interpret the data obtained from it and provide feedback.

Teachers are not only users but also data providers. In line with all these explanations, policy makers for educational environments should take effective and solid steps for digital transformation in education (Savas, 2021).

The areas where productivity is achieved by using the data that emerged with the digital transformation brought by the age, together with data mining and big data studies, are increasing day by day. In the next sections of this chapter, the importance of data mining and big data in digital transformation is mentioned, the concepts of data mining and big data are explained, and the contributions of data analysis to efficiency are explained. In the last part, the contributions of these disciplines are discussed and the conclusions are explained.

The Importance of Data Mining and Big Data in Digital Transformation

ICTs are in continuous development. Besides, the number of areas which are using ICT is also spreading. The digital data produced in areas using these technologies continue to grow exponentially over time (Savas et al., 2012). All institutions using ICT save the data produced by computer systems and electronic tools in their institutions' data warehouses. The data kept in data warehouses reach huge amounts over time and it becomes difficult to reach meaningful information from these data when viewed with the human eye. This data only starts to make sense when it is processed for a specific purpose because it is not possible to make decisions based on raw data. It cannot be expected that the decisions taken will be appropriate and correct. The purpose of collecting data is to reveal the information contained in the data that cannot be seen or noticed with the human eye. Then, with this information, decisions are made for the future of the institutions. For this reason, programs, algorithms, and techniques that help analyse large-scale data have gained great importance today (Savas & Topaloglu, 2011). As we pass through the times of the data revolution, how and for what purpose these data will be processed remains an up-to-date question. Data is just as important today as raw materials were in the times of previous revolutions, and even more (Savas, 2021).

Especially after the 2000s, with the widespread use of computer systems in every field, manual calculations began to be insufficient. This is where data mining came into play and when the results it produced were successful, it became more and more widespread.

Data Mining

Data mining is the process of discovering patterns and trends hidden in large data sets (Buyrukoglu, 2021a; Thuraisingham, 2003; Uzut & Buyrukoglu, 2020). If we make a broader definition; data mining is the process of accessing and using meaningful data that can enable us to make predictions about the future from databases where a large amount of information is stored, in line with our purpose (Buyrukoglu, 2021b; Savas & Topaloglu, 2011; Uzut & Buyrukoglu, 2020). Data mining is one of the most important disciplines for businesses. Very-large-scale data, large-scale databases in different fields can be thought of as a data mine containing valuable data. The analysis of data of this size, the task of obtaining more meaningful information as a result of this analysis, and interpreting the information obtained exceeds what human skills and relational databases can do. In particular, the explosion of the increase in the amount of digital data and the constant number of people who research and practice on this data have forced studies towards data mining. As a result of these needs, a new generation of techniques has emerged for automatic and intelligent database analysis.

These techniques should be such that they can transform data into useful information in an intelligent and automated way. As a result of all these, data mining has been presented as an answer and has become an increasingly important research area. Due to its importance, it has become used in many different disciplines (Figure 1).

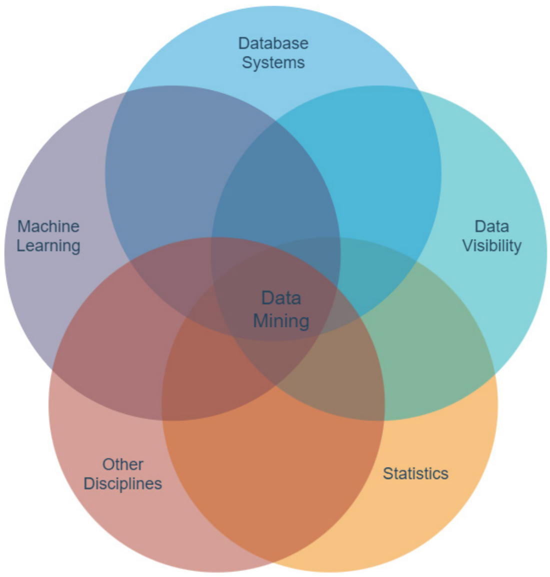

Figure 1. Data mining and other disciplines

The most important feature of data mining is that identifying similar trends and patterns among data groups can reveal interesting information within data warehouses that cannot be detected in the first place.

Data mining is basically affected by 5 main factors: “data”, “hardware”, “computer networks”, “scientific calculations”, and “commercial trends” (Akpinar, 2000). Data, which ranks first among these, is the most important factor in the development of data mining. In the hardware factor, the developing memory, processor speed capacities, and graphics card capacities have made it possible to work on data that could not be mined before. The most important element under the umbrella of computer networks is the widespread use of the Internet. The scientific calculations factor mostly covers the research/development studies of today’s scientists and engineers. Commercial trends are a factor that directs the work, because today, businesses must act faster, provide higher quality services, and consider the minimum cost and minimum work force in order to maintain their existence in a competitive environment.

Considering the data handled in exponentially increasing dimensions, the existence of many problems should be taken into consideration. In data mining operations, it may be necessary to deal with many problems such as residual data, empty data, uncertainty situations, dynamic data, missing data, handling different data types, noisy data, missing data, limited data, and database size.

Data mining is also a process. In addition to revealing the data by making abstract excavations among the data piles, it is also a part of this process to filter the patterns by separating them in the knowledge discovery process and make them ready for the next step.

The steps followed in the data mining process are generally as follows (Shearer, 2000):

- Defining the problem,

- Preparation of data,
- Establishment and evaluation of the model,
- Using the model,
- Monitoring the model.

After this process followed, knowledge discovery from databases is carried out. Data mining operations in the processes of accessing information are shown in Figure 2.

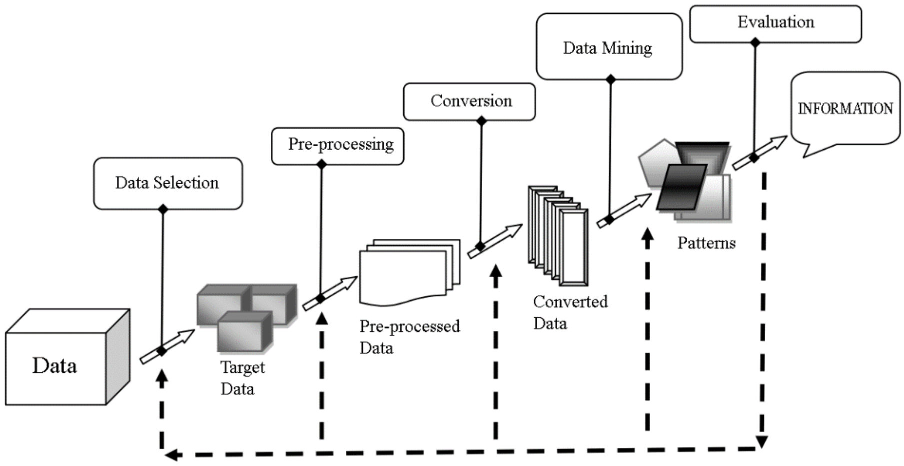

Figure 2. Data mining in the knowledge discovery process

As a result of scientific studies, the methods and algorithms used in data mining are constantly increasing. While some of the techniques used are based on traditional statistical methods, machine learning and deep learning methods have become frequently used, especially with the acceleration of artificial intelligence studies in recent years. Data mining models can basically be grouped under the headings of classification and regression, clustering, and association rules according to the functions they perform.

Big Data

On the one hand, data mining methods and information discovery processes continued, on the other hand, the variety of data produced in cyber environments continued to increase, especially in the last 15 years. With many work areas and structuring included in human life such as Industry 4.0, Internet of Things, Social Networks, Sensor Technologies, and Automation Systems, the size, speed, and diversity of data flowing in cyber environments have almost become the limits. With that, a new discipline has emerged, now called big data.

Big data means storing, accessing, and processing information in a wide variety of high-volume and high-speed data. Processes such as analysing these data, recognizing patterns, and revealing hidden connections mean big data analysis and are at the top of the agenda of technology companies in today's world, both because of their performance and management difficulties, and to create competitive advantage (Sagiroglu & Sinanc, 2013). It is not possible to manage, process, and extract information of high volume, complex, and high-speed data with traditional database management systems. Therefore, it requires different algorithms, techniques, and technologies, such as software running in parallel on server clusters (Jacobs, 2009).

For these reasons, platforms such as Hadoop and Spark are used instead of traditional computing approaches, computer clusters, distributed file systems such as HDFS and RDD, traditional programs, and programming languages. These technologies, which have started to be used in data storage and processing, have also affected the machine learning methods used in data analysis. Machine learning algorithms are used for many purposes such as sentiment analysis, accuracy detection, recommendation systems, social network discoveries, medical discoveries, discovery, and classification of web content (Hallac, 2014). The elements that make up big data include volume, velocity, variety, veracity, and value (5V) (Zikopoulos & Eaton, 2011).

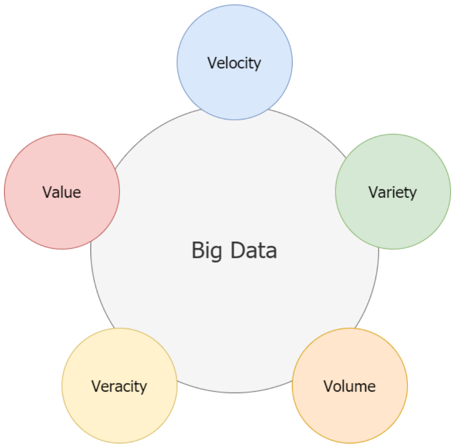

Figure 3. Big data components

***5V*:** Large volumes of data are often mandatory for big data because with this feature the data becomes unmanageable (Volume). If data is stored fast and data processing elements cannot keep up with this fast-loading, the system becomes inefficient or data loss begins. Because there is a general principle in information systems. Fast adapts to slow (Velocity). In most big data applications, there are more sources or data types than a single data source or data type. For example, most companies provide information about the target audience for their advertising campaigns; they personalise their campaigns by taking places such as social media shares, comments, internet navigation information, searches in search engines, location information, and interests. Thus, structured and unstructured data are brought together (Variety). As the volume of data increases, its quality must also be preserved. Especially before processing the data, the type of sensor needs to be determined. The data type also needs to be validated. Fake data needs to be separated from real data (Veracity) (Savas, 2020). The data is a treasure for the digital age (Value).

Data Mining and Big Data in Digital Transformation

The age we live in is now called the digital age. It is known that digitalization increases the efficiency of companies of all sizes and makes them more competitive. Since the limits are lifted in the digital world, although not physically, the brand promise should be positioned not only for the current markets and target audience, but also according to the target audience in the global market, and the brand value should be tried to be increased (Altuntas, 2018). Technological developments, which are accelerating day by day and are included in our lives, force businesses to participate in the digital transformation movement to increase their efficiency and competitiveness in the market. Driven by data mining, big data, cloud-based technologies, digital document workflows, and customer experience enhancement applications, digital transformation constantly provides new opportunities for businesses to work better, improve collaboration, and make business decisions based on objective data (KYOCERA, 2021).

Digital transformation is the use of information technologies in many different fields, as a result of rapid access to information, and saving time and money. Transformation refers to the rapid shift of all fields to technological channels and the continuation of activities in the digital field. It is possible to see this in many daily activities, especially in the business world. In most areas, many works that were done in the physical environment can now be completed in seconds in the digital environment (Yazilim, 2021).

Developed and developing countries of the world attach importance to data mining and big data studies in their digital transformation processes. In Türkiye, it carries out its big data studies with strategically determined studies. A digital transformation office has been established for these processes and large-scale studies are being carried out. As of September 2021, 56,491,566 users benefit from e-government services, which is Türkiye's digital transformation gateway, and 5,971 services are provided by 818 institutions on this platform.

The Digital Transformation Office of the Presidency of the Republic of Türkiye states the importance given to this issue in Türkiye as follows:

"*While the determinant of the last century was the production power and the added value obtained from it, today the determinant of the power is expressed as the data and the ability to process them. The basis of the data economy is to process data and turn it into a value. The fact that the owned data is not only an economic response but also a value that can affect every stage of political and social life affects the struggle for the existence of countries and causes them to develop new policies. This new economic and social model, which is based on data and whose rules have not yet been clarified, reshapes every stage of life. The transformation of data into value is only possible with a domestic and national understanding. Just as every inch of our country's land has value for us at the expense of our lives, we look at every byte of our data with the same eye. In this context, it is of great importance that every byte of data remains within our own borders and is protected. In order to generate value from data, the big data we have must be anonymized and transformed into a usable form*" (TCCBDDO, 2021).

Digital transformation provides organisations with benefits such as time, efficiency, reduction in expenses, reduction of errors caused by personnel, sustainability, consistency, automation, instant analysis, and effective management process. "Technology", "Process", and "Human" elements are very important for digital transformation (Yazilim, 2021). While focusing on technology and process elements, the human factor, in particular, should not be overlooked. Because digital transformation, with the automation of routine processes, will cause some professions to disappear in the coming years. According to the future professions report published by the World Economic Forum in 2016, employment in many sectors will decrease and some professions will disappear due to increasing automation and robotic technologies, and at the same time, new jobs and new employment areas will be created due to new needs (Forum, 2016).

Many professions made using physical strength are in danger of extinction because they can be easily done by robots with the effect of digital transformation technologies. Occupations that will be most affected by digital transformation are those with the highest probability of computerization (computer-based automation).

Various occupations, such as secretarial and administrative assistant, assembly line worker, machine operator, logistics, cargo and shipping agency, travel officer and agency, tour guide, accountant, bank clerk, office clerk, cashier, driver, train driver, shop, restaurant, hotel personal, financial advisor, personal insurance advisor, retail sales job, library technician, courier, farmer, security guard, call centre operator, laboratory technician, and repairman are at risk (Gokalp et al., 2019; Lorenz et al., 2015; TUSIAD, 2017).

There is an increase in employment in engineering and computer-based professions with adaptation to technologies within the scope of digital transformation (Lorenz et al., 2015). Due to digital transformation, new professions are expected to emerge such as industrial data scientist, robot coordinator, autonomous vehicle fleet manager, cloud computing specialist, industrial user interface designer, internet of things solution architect, industrial computer engineer, 3D printer engineer, wearable technology designer, data security specialist, network development engineer, smart city planning specialist, edge IT specialist, virtual shopping consultant (Gokalp et al., 2019).

When attention is paid to these professions, it will be easily seen that almost all of their raw materials and/or results are "data". This is where the concept of big data comes into play, and future-oriented decisions are made with big data analysis or data mining.

Contribution of Data Analysis to Productivity

Productivity generally means "effective use of resources and is defined in two ways as partial factor productivity and total factor productivity. While the productivity of the factors indicates partial factor productivity, production per total input is defined as total factor productivity. In other words, it shows the remaining part of economic growth that is not caused by factor increases, that is, after the contribution of inputs to production is calculated (Shackleton, 2013). Increasing productivity is accepted as the main determinant of economic growth in the long run (Unlu, 2021).

Processes that become more sustainable, productive, and efficient with digital transformation contribute to good planning of production. To put it more clearly, the efficiency of processes can be defined as the elimination of repetitive work, more efficient use of human resources, and employment in innovative works thanks to automation systems. Thus, digital transformation contributes to saving time and money by increasing productivity directly and indirectly. Thus, innovative ideas such as a domino effect will make it possible to introduce new products.

In human resources management processes, the importance of digital transformation has emerged as less time, budget, and human resources are used for many tasks that were previously performed manually, and thus lower costs are needed. In addition, digital transformation facilitates the processes of collecting, recording, recalling, and documenting human resources management data when necessary, can be said that it is effective in making strategic decisions for business managers, and finally, it enables business personnel to work more efficiently. However, thanks to digital transformation, businesses increase the speed of processing, obtain higher quality outputs, and significantly reduce stationery costs (Calp & Dogan, 2019). Considering the value created by the data for the institution, the collection and cost-effective storage of operational data is extremely valuable in terms of being a source for future analysis studies. Mainly in the big data industry, predictive maintenance, production, quality optimization, digital twin, autonomous digital factory, flexible production methods, online factory, integrated planning, production planning, sales forecasting, and many more.

The use of instant data and its prospective storage is the most sensitive issue for accurate analysis. With machine learning, it is aimed to make decisions with big data by providing minimum human intervention. Information is obtained by collecting and analysing data from devices. Experience is gained by gathering and evaluating information, and wisdom is achieved based on these experiences (ISODijital, 2019). In the management of institutions, the control of operations and making important business decisions based on objective data is the most critical issue for a business. The widespread use of data analysis platforms, the increasing prevalence of business analytics applications, and the development of data collection tools thanks to the Internet of Things are among the most important factors of this transformation. One of the most prominent benefits of digitalization is the increase in the quality of the meaningful data obtained and the support of these meaningful data in making decisions that will have positive results in terms of business efficiency, resource use, and customer satisfaction (TrioMobil, 2021).

Emerging applications such as smart production processes and product lifecycle management have started to come to life in real life with big data. Active preventive maintenance in smart production systems can be implemented through big data analytics. With the support of big data in the production area, many real-time device data such as device alarms, device problem records, and institution notifications can be collected in order to evaluate the status of production devices and to detect malfunctions in advance. Armed with the insight that big data can provide, the industry can improve quality, reduce losses, and acquire key transactions in today's highly competitive market. The increasing number of analytics-based manufacturers means more agile business decisions and faster problem-solving. With the analysis of big data, great development and innovation will be achieved in all areas of the industry (ISODijital, 2019).

Discussion and Conclusions

The common conclusion to be drawn from the studies examining the effect of digital transformation on employment management is that the management of automation that provides continuity with digital transformation will cause many complexes to arise, and with this complexity, their professional capacities should be fed with much more complex competencies (Gokalp et al., 2019).

Digital transformation will especially contribute to the economies of countries, such as meeting customer expectations, flexibility, appropriate value decision making, resource efficiency, and effectiveness, creating value opportunities with new services, responding to the demographic change of the workplace, work-life balance, and being a competitive economy even with high wages (Kagermann et al., 2013; Kurt, 2020).

To survive in competitive environments, the most important issue of businesses at the micro-level and the states at the macro level is to use data, which is the raw material of the digital age, effectively and efficiently. In every period of history, the raw material has been valuable depending on the state of the industry. In our age, digital data comes to the fore as a raw material with Industry 4.0. Data collected from almost every device, every platform, every individual, and community is collected regularly and continuously in data warehouses. These data do not make sense when they are stand-alone. This is where data analysis comes into play. Data mining and big data disciplines are the most important disciplines in reaching information from data and making informed decisions. Informed decision-making is one of the most important factors for productivity. Because today, managers of institutions base their predictions on data analysis.

Today, prevention of many disadvantages such as loss of effort, loss of time, unnecessary use of human resources, and energy consumption, in other words, efficient use of all resources, is only possible by making decisions based on data analysis. Data mining techniques offer important opportunities to make and implement these decisions. Big data analysis, on the other hand, contributes to getting out of structures that are more complex, making predictions for the future, and making business decisions more effectively. In addition to all these, the need for experts to work on these issues will increase in the future. Productivity is no longer a need for businesses and becomes a state policy. Thus, there will be a need for the workforce to implement these policies. Increasing productivity by making data-based decisions shows itself as a need in every field from energy to production, from human resources to management mechanisms. In our age of data revolution, accelerating data mining and big data studies and giving the necessary importance has become a necessity, not a choice.

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CHAPTER

Management of Data, Innovation and Changing Competition in Digital Transformation

5

Hakan YUKSEL

Management of Data, Innovation and Changing Competition in Digital Transformation

Hakan YUKSEL

Isparta University

Introduction

With the effect of rapid advances in information and internet technology applications in recent years, it has become a necessity for businesses to keep up with the times. This process has accelerated industrial activities, production, and the harmonization of all other components related to production. In addition to designing new business models, it is necessary to make a digitalization-based transformation as businesses change their way of doing business. When we consider digital transformation within the scope of production, it is also seen as the process of developing information strategies for cooperation and improving a company's products in a global environment using information technologies. Transformation should not only be within the scope of its business model, production or activities, but also the managers who manage the transformation should combine digitalization with innovation and creativity, and try to present and create the technology of the future in advance. With the emergence of new technologies, products, services, and business models, the leaders of tomorrow should be ready to adopt a different corporate structure in businesses where it has become a necessity to determine the principles of digital transformation. Providing the adaptation process to the digital transformation, which is seen as the vision and mission of the future, and the realization of the transformation have special importance in terms of competitive advantage.

Digital transformation plays an important role in the process of industrial activities as it supports innovations and changes in product development. Digitization can be expressed as a reflection of the adoption of digital technologies in business and society, as well as related changes in the connectivity of individuals, organizations, and things. In the digital world, which is developing at an unprecedented pace with the development of the digital age, while the assimilation of digital technologies continues to progress rapidly, businesses are also trying to transform rapidly. Businesses that adapt and adopt this process in a short time will make their activities sustainable, while those that do not will become more passive and maybe even face the danger of extinction.

Digitization is the inclusion of all kinds of objects in the digital network using information and communication technologies. Although the Internet has been called virtual until now, it can now be called physical. Because now it has become a technology that touches people and becomes a part of them. Digital transformation emerges with the blending of personal and corporate information technology environments and covers the transformational impact of new digital technologies such as social, mobile, cloud and internet of things in businesses (Sebastian, et al., 2020). Digital transformation includes the application of digital technologies to change basic business transactions, products, processes, organizational structures, and management concepts (Saglam, 2020). Table 1 shows the digitalization forecast figures for the world population and connected device increases (Sahinaslan, E. & Sahinaslan, O., 2019).

Table 1. Digitization forecast figures by years

Year	World Population (Billion)	Connected Device (Billion)	Number of Devices Per Person
2003	6.3	0.5	0.08
2010	6.8	12.5	1.84
2015	7.2	25	3.47
2020	7.6	50	6.58

When the figures in Table 1 are examined, it is seen that the world population grew by approximately 5.5% between 2015 and 2020, while the increase in the number of connected devices was at the level of 100%. Parallel to this, the level of increase in the number of devices per capita is about 90%. These increases naturally trigger world market increases.

Digital transformation does not mean digitizing the business by replacing the old technology with a new one without changing the way businesses work (Accenture, 2015). Digital transformation creates radical changes in the way businesses do business, the living standards, and the processes of individuals and societies (Sahinaslan, E. & Sahinaslan, O., 2019). Integration of new needs into the existing process in the analysis and planning of the digitalization process. In addition, it is also planned to remove the process steps of the existing process that are ineffective or that will no longer be needed with new technologies. Designs made by removing process steps that will no longer be needed or add value increase the success and usability of the digitalization process. While designing the digital transformation process flow, priority should be given to making the process flow user-friendly by supporting the opportunities and opportunities offered by appropriate new technologies, in addition to the basic process flow that should be in a standard process such as entry, query and approval. Otherwise, the expected efficiency from the transformation cannot be achieved, and the excitement and motivation of the employees towards the transformation may be disrupted. It may even be subject to strong user resistance. The most difficult part of digital transformation for businesses is to create the necessary capital infrastructure for technology, as well as to manage change within the business, and provide a mentality transformation for employees to adopt this change. Today, it is not possible for businesses to provide and change the way they do business and customer satisfaction only with new technologies. A successful digital transformation in businesses is closely related to the creation of change in business culture, the change management process, and other strategic approaches. Because of the development of digital technologies and the impact of digitalization on all business processes, managers will need to understand how the transformation will affect their operations. In this process, it is important how the managers will follow the path to realize the digital transformation, what kind of strategies they will include, and how they will evaluate the situation of the business. With the emergence of new technologies, products, services and business models, the leaders of tomorrow should be ready to adopt a different corporate structure in businesses where it has become a necessity to determine the principles of digital transformation. Studies on digital transformation have shown that the increasing competitive positioning of successful firms is not only dependent on the technologies they adopt, but more importantly, on the strategies developed by their leaders (Ismail, et al., 2017). While the building blocks of a digital transformation strategy for managers are known, clearly defined rules on how to approach digital transformation and implement a well-defined digital transformation strategy are lacking (Hess et al., 2016).

It is argued that digitalization changes the interaction of employees in the workplace, their expectations from employers and careers, and when and where work is done. In this sense, the development of digitalization affects institutions on many levels internally, as it requires the adaptation and development of new knowledge and new ways of working (Bondarouk & Ruël, 2009). In order for businesses to adapt to today's process of change, they need to question themselves more and more every day and eliminate their deficiencies in order to adapt the structure and strategies of their businesses to change. Digital transformation, which affects the ways of doing business, designs, models, and processes in order to improve the performance and activities of businesses, requires the capabilities that companies should have for the collection, processing, and analysis of data (Schallmo & Williams, 2016).

The dynamic capabilities of businesses are of great importance in the realization of digital transformation in an increasingly competitive environment. It will be easier for businesses that want to gain a competitive advantage in a constantly changing business environment, to choose appropriate internal and external resources to create different dynamic capabilities and to realize digital transformation as a result of having these resources. In this study, the effects of data, innovation and changing competition process on the administrative processes of enterprises within the scope of digital transformation were examined. Each of them was examined under separate headings and the facts in the digital transformation process were discussed one by one.

Data in Digital Transformation

We can define the data, which is the raw material of digital transformation, which can cause a change in many activities in the daily lives of individuals, production, health and working life, as the results obtained based on observation and experimentation in its most general form. It is a fact that data alone does not mean information and meaning. Information can only be accessed by cleaning, processing, analyzing, and interpreting the data (Yilmaz, 2009). The discovery of information in data has been made possible by the application of special algorithms that can capture patterns in big data. Although this process is developing day by day, it is possible to obtain high-quality information from low-level data by using machine learning, artificial intelligence, and statistical methods (Fayyad et al., 1996).

In almost every stage of his life, increasing digitalization has brought with it huge amounts of data. In the 1990s, John Mashey introduced the concept of big data in the literature. While the concept of big data and its analysis was initially an interesting concept for statistics, computer science, and econometrics departments, today it has become a popular and even mandatory concept that changes and develops engineering, health, production, R&D, and many other fields (Ularu et al., 2012).

The development of internet-based smart systems has led to a significant increase in the amount of data produced all over the world. While the digital data produced in 2015 was approximately 15 zettabytes, it is estimated that this rate will be approximately 160 zettabytes in 2025. As can be seen in Figure 1, digital data production has followed an increasing trend over the years (Rydning et al., 2018).

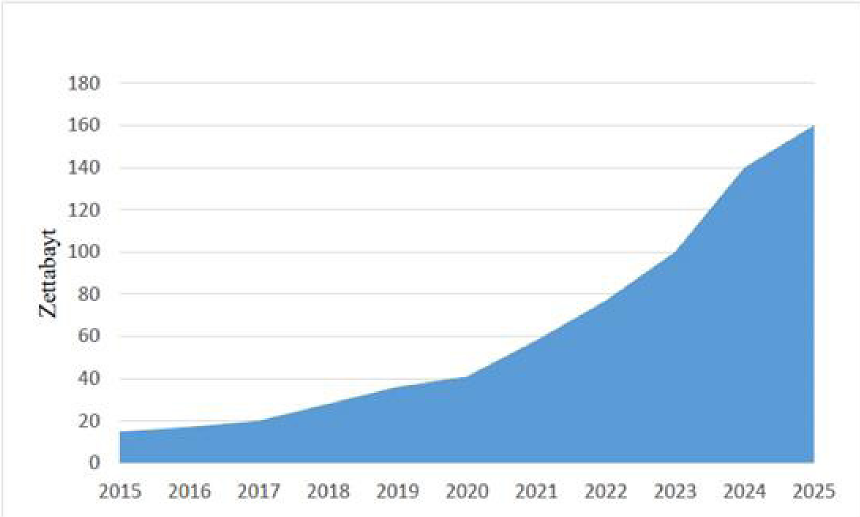

Figure 1. Increase in digital data by years

What makes the data import is the analysis of the obtained data. Big data analysis enables the inactive information to be processed and transformed into information that creates value. Technological structures that will enable data to be analyzed will also serve the benefit of people.

Data Analysis

Digital data is huge in variety and volume. Today, while the data produced almost every second increases, the storage costs, technology, and costs related to the analysis and processing of the data have united the users to the point of obtaining high benefits (Kokhan, 2021). Because the cost-benefit analysis of analysis processes that require investment costs should be stronger in terms of investors and users. The real benefit in data will be provided by the technology that can store and analyze unstructured or semi-structured data and the correct use of this technology with trained human resources (Gupta & George, 2016).

The potential value of big data is only realized when it is used to power decision-making. To enable this type of evidence-based decision-making, organizations need a variety of processes to meaningfully transform high-volume, fast-moving, and diverse data. These processes consist of five stages data management and data analysis shown in Figure 2 (Gandomi & Haider, 2015).

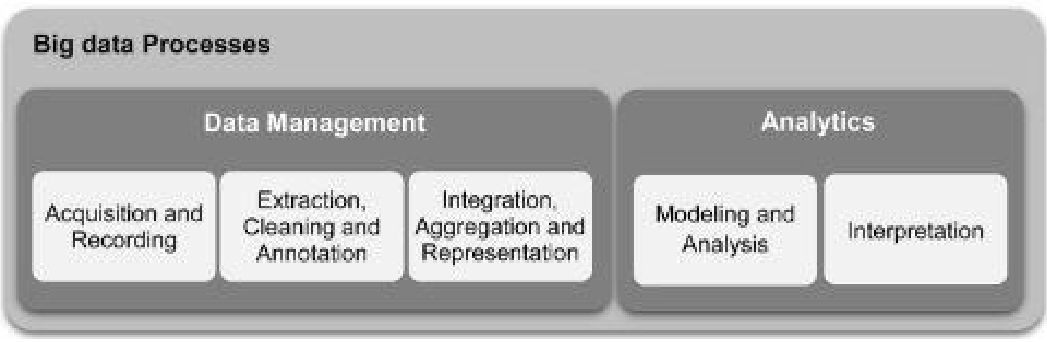

Figure 2. Processes for extracting insights from big data

The following benefits are provided by big data analysis (Manyika et al., 2011);

- It makes the data more transparent and useful and important to the business.
- As organizations create more functional data and store it in digital format, they gain access to much more precise and detailed performance information.
- Big data gives even small companies a chance to be stronger in their competitive environment.
- Thanks to big data, consumers can access many goods and services unique to them more easily and quickly.
- Complex analyzes make decision-making significantly easier. The potential of all decision support software known today will be developed by big data like never before and not anticipated.

Application Areas, Challenges, and Challenges of Digital Transformation in Institutions Risks

Production technologies have been the fundamental steps leading the transformation. Digital transformation in the industry, leaving behind the old technologies, cyber-physical smart systems, smart factories, internet of things, big data, cloud computing, etc. entered our lives with concepts (Hermann et al., 2016).

Barriers such as not knowing how to benefit the whole society, lack of skills and skilled workforce, inadequate infrastructure, incomplete or inadequate regulation, and consumer protection, and especially difficulty in obtaining finance are some of these challenges (Ebert & Duarte, 2018).

With digitalization, instantaneous data becomes more integrated into the information transformation process and decision-making mechanisms. Insights provided by not only structured but also semi-structured or unstructured data can help improve the quality of service delivery in the public and private sectors, and make effective decisions. Mechanisms, effective risk management and strategy development, etc. it will create a transformational benefit on the basis of all sectors by contributing in many aspects (Marr, 2019).

Advantages of Big Data

Digital transformation has led to very effective changes in businesses. Changes in production methods, production systems that require fewer people, unmanned dark factories that produce with smart sensors, etc. These situations have led to the birth of new professions and the design of new ways of working. It is very important to be able to make accurate predictions in order to understand the effects of all these changes in working life and to put the policy response on the right ground. At this point, it has become an important issue to read about the digital transformation experienced with the right insights (Papas, et al., 2018).

Big data, technology infrastructure, and manpower trained in analysis have high investment costs, but the opportunities it offers, its superior performance in decision-making mechanisms, more effective product development, and an efficient approach that will reduce costs in the medium and long term (McNeely & Hahm, 2014). In many organizations that have just realized their digital transformation, if the structural changes are made by big data, proper storage, processing and conversion of data into insight, an effective solution-oriented, better decision-making, cost-effective, auditable, secure, and sustainable service model can be developed (Nickerson & Rogers, 2014).

Innovation in Digital Transformation

In recent years, the combination of digitalization and innovation is one of the most focused topics in all sectors. It is known that both concepts alone have great effects on the success factors of businesses. He emphasizes that researchers have recently taken an intense interest in digital innovation in parallel with the approaches in the industry (Brynjolfsson & McAfee 2014; Chesbrough, 2017). The successes of businesses in using information technologies in all their processes have led them to digital technology-based innovation in their new products and services. In this case, information technologies as a driving force cause radical changes and transformations in products and services in all sectors.

It is seen that businesses try to include inter-industry and inter-individual cooperation in the innovation process by using the advantage of information technologies in order to reach innovative approaches on issues such as ensuring effective resource use, expanding the differentiated and personalized product portfolio, and increasing productivity. Innovation policies are also tried to be created for different sectors, individuals, cultures, and perspectives to use networked thinking in harmony. Today, many businesses share their innovation processes. Businesses that gained their competitive power from research and development activities carried out within the boundaries of the company in the past, today create platforms where they can use collaborative approaches more in their innovation strategies.Considering the concept of digital innovation from a broad framework, it has been defined as significant changes in the product, process, or cooperation models of enterprises, perceiving them as new and their concretization with information technologies (Yoo et al., 2010). With digitalization, products have begun to take on different and complex dimensions. In other words, a digital-based product can have features that can be programmed, smart, monitored, and connected to other devices with information technologies integrated into its structure. The effect of digital technology on the acquisition and development of new information has also led to the rapid digitalization of information. With the rapid developments in communication technology, the development of processing power in devices, the availability of easier options in service processes, and the development of product designs has emerged as the unifying values of digitalization. This emerging situation differentiates digital innovation from the previous ones. This digital innovation presents a more complex and difficult structure compared to others.

This new approach brings new opportunities and risks for businesses. The fact that the customer and market structure has a more heterogeneous structure every day has forced businesses to design new products/services by taking into account the reality of very different customer expectations. This situation has led to the formation of important new perspectives such as faster and more flexible structuring, leaving the previously closed innovation to open innovation-based cooperation, following technological innovations in internal and external environmental analysis, and logical change in product/service design. It is seen that the digital innovation process has a structure that differs significantly from the analog innovation process. In order for businesses to be successful in digital innovation, their competence in using digital technology in the product/service process and their desire for this competence are very important. It is essential for businesses to follow digital technology innovations in their own and other sectors and integrate these changes into their own processes.

Otherwise, it will lag behind the rapidly changing digital technology. Digitization comes to the fore with its unique features, which enables the awareness of digital innovation to emerge and the business to develop an effective differentiation strategy against its competitors.

Digital Innovation Strategy Management Processes

Digital innovation, at any scale, should be a vital part of business strategy within the scope of innovation and R&D efforts. Innovation is not something that can happen alone. For this, it may be necessary to innovate in the production processes, the technology used, and the production methods. Process, technology, and method change should provide a competitive advantage to the business by reducing production costs. This competitive advantage will not only give the company the opportunity to become a sole supplier, but it will also discourage those who want to enter the market (Aksu, 2019). Within the scope of digital innovation, businesses are faced with three basic structures. These; The digital environmental structures of the enterprise in its own and other sectors, the acceptance risks of the products and services of the enterprise in the market, and the ability of the enterprise to meet the market demands. Since these three basic issues interact with each other, businesses should act in integrity while evaluating these basic situations. In recent years, there has been intense and fast competition in all sectors. Against this competition, businesses need an effective and efficient digital innovation process management while using their resources. Three key elements will be important when assessing the digital innovation capabilities of the business structure. These are the organizational structure of the business, the logic of product development, and the analysis of the digital environment. Figure 3 shows the important parameters for managing a successful digital innovation strategy.

Figure 3. Digital innovation strategy management processes

Organizational structures of the business

The business wants to develop its existing products with digital technology and use it as a change effect for itself. In order to realize this action, the structural features of the business in the learning process of new technologies are at the forefront. It is necessary for the business to effectively implement a sustainable innovation learning strategy in its own life cycle. The desires and attitudes of the managers and employees of the enterprise in this direction are the basic conditions of success. With the establishment of this continuous education relationship, the business should constantly encourage its employees to follow and acquire digital competencies.

Product development logic

The digital innovation learning process will be more effective when the innovative ideas of the employees in the business structure are provided with the opportunity to create a spontaneous innovation initiative within the entire business with the idea platforms. It is essential to consider the product and service based on digital technology. With the establishment of a continuous education relationship, continuous encouraging behaviors should be exhibited in order to follow and acquire the digital competencies of the employees of the enterprise. Effective use of external stakeholders in the design process is very important for knowledge, which is one of the basic conditions of successful product design.

Digital environment analysis

Digital technology is in continuous development and transformation with different innovations in different sectors every day. This will be possible by constantly monitoring digital technology and analyzing how the business will use it in its product and service portfolio. In this way, the harmony of the employees with the digital technology will be realized within the business process, such as improvisation. Businesses can make these analyzes more effective with special working groups that will follow the near external environment analysis.

Competition in Digital Transformation

When businesses consider competition as a roadmap that includes fixed movements in an unchanging time period, they cannot determine the effects of their own competitive strategies and the effects of businesses that are directly or indirectly affected by these effects (Turkkan, 2001). Considering that competition takes place in a dynamic process, designing this process in a dimension that includes the necessary flexibility and counter-interactive maneuvers will ensure that businesses are prepared for the developing conditions and the agenda that can change at any moment.

Dynamic dimension of competition process in digital transformation

The awareness that competition is a dynamic structure should be considered both for businesses and potential competitors. Today, as a result of increasing competitive pressure, the emergence of various technological innovations in the medium and long term and the possibility of being open to development make the final results of competition unpredictable. As a result of these situations not being foreseen, businesses are forced to withdraw from the competition by failing. In order to eliminate these dangers, it is becoming more and more important for businesses to create dynamic competitive strategies with dynamic features by calculating the new formations that will emerge in the context of their past experiences and future predictions.

Competition components

It has become one of the main tasks of business management to be able to accurately reveal and make sense of the components that give dynamism to the competition process.

Future orientation

The most important reason for the future-oriented design of competition is that although people do not have the opportunity to turn to the past and reorganize the past, the initiative to shape the future is always in question (Goldsmith, 2004).

In this process, businesses should be sensitive to their customers and customer-oriented, be environmentally sensitive and take environmental responsibility, and reconcile uncertainty and risks with opportunity openings. Being aware of the fact that we live in the age of value, it should be able to make serving its customers the most important feature of its identity (Howard, 2005).

Collaboration focus

The need for businesses to differentiate themselves from their competitors is based on the ability to focus on a specific area and create the ability to specialize in that area. In the globalizing competitive environment, businesses act with the logic of competition instead of individual competition, cooperation instead of conflict, and instead of me, in order to use limited resources in the most effective way, facilitate resource availability, to increase the synergy of technological processes, logistics, marketing and human resources and to benefit from expertise skills. Who is our strategic partner? They should ask themselves the question (Hanan, 1996).

Talent orientation

The most important factor that brings dynamism to the competition process is that businesses are prepared against the uncertainties of the future and possible changes that may occur according to the degree of certainty of these uncertainties. The only factor that can eliminate the difference that may arise between the current strategic formulations and the changes faced and prevent the interruption of the competition process is the talent and skill portfolio of the human resources of the enterprises.

Speed orientation

Being future-oriented, benefiting from the synergy created by joint competition and relying on their talents are the building blocks of the road to dynamism. But while creating all these, businesses need to get ahead of their competitors, who have the capacity to experience the same processes, without ignoring them. Businesses that cannot reach speed will be doomed to be surpassed by their competitors. The most critical and fragile element of global competition is the time factor.

Ways to maintain competitive dynamism

The competitiveness of the business will depend on its digital capabilities. The digital capability of an organization is the ability to communicate correctly with customers, suppliers, and internal and external environment elements and to use digital channels effectively in relation to these environments. Moreover, these channels can reduce the cost of commercial processes. In this way, competitors with high digital skills that will enter the market will scale up very quickly by using these skills, and they will be able to put even companies that are the leader of the sector in a difficult situation.

Thanks to their digital capabilities, organizations can find the opportunity to act on common ground with other organizations and even competitors in the marketing of other products and services that are close to and complement the goods and services they offer, and can even be purchased with them. Labor costs can also decrease in businesses with high digital skills. Because software, robots, and artificial intelligence applications take the place of employees in many fields. As a result, even if they are very strong at the moment, organizations that ignore the current global digitalization process and do not aim to develop their digital capabilities in their strategies will soon face competitive difficulties.

The Process of Digital Transformation

The process of realizing digital transformation should be managed within a plan. Businesses that want to initiate digital transformation must first define their vision, understand their capabilities, explore opportunities to start new ventures and restructure their operations by making the necessary preparations (Figure 4). The business should also address strategic questions about each of the following issues (Rose, et al., 2016, p.8):

Define the vision. It is about understanding the evolving customer needs and competitive environment and redefining the vision accordingly in order to realize the desire for digitization. Is digitization a threat or an opportunity? How the market developing and what is are our competitors doing? Should we create new businesses or improve our current cost position? Questions such as answers are sought. Submitting New Offers. It's about better meeting customer needs in existing businesses or creating new multi-billion-dollar growth opportunities with new venture portfolios. Questions to be answered; How do we define a portfolio of new digital business opportunities? How do we create a business case to invest in digital growth? is in the form.

Strengthening Core Business Processes. It's about redesigning and rethinking business processes. The aim is to increase the effectiveness of incremental change in operations and improve the customer experience. How can we use digital to get better efficiency from the business? How can we optimize our operations? Questions are addressed.

Building a Strong Digital Foundation. It is the establishment of the basis of digitalization by evaluating the organizational structure, business processes, tools, infrastructure, employees, and stakeholders of the enterprise. How does the current organization compare to the vision for the future? How do we acquire the skills needed to bridge the gap and develop the business in that direction? This is the final step in seeking answers to your questions.

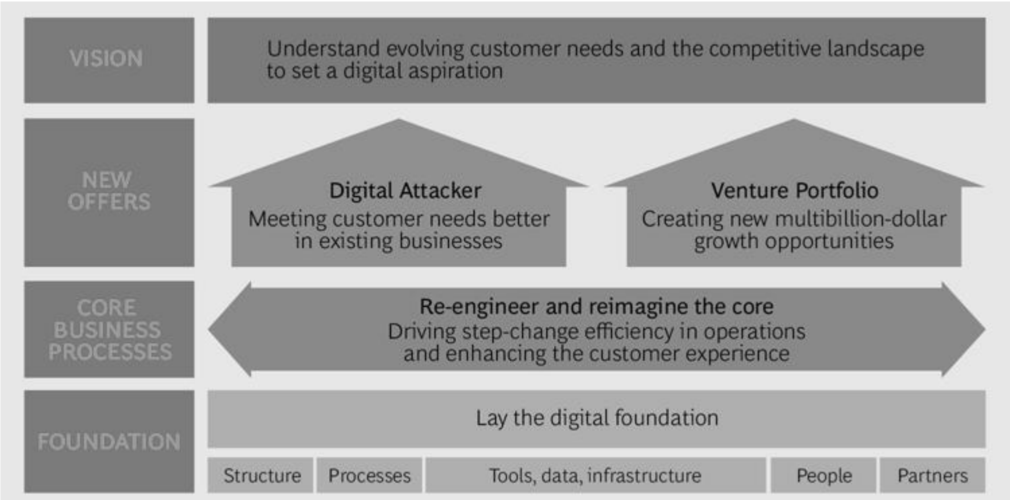

Figure 4. The process of digital transformation

It has been determined that it will guide the effective digital transformation program in three stages (CapGemini & MIT, 2011):

1. Thinking about the digital future for the business: Many digital transformation initiatives cannot add value to the business because they do not have a digital vision. The firm's senior management must create a digital vision for the future and communicate it to the organization. Successful digital transformation is created from the top down. The real value of digital transformation often comes when it is valued between silos and then helps others see that value.
2. Investing in digital initiatives and skills: Transformational activities require investment. Investment activities are a strategic risk-bearing decision process to be carried out by senior managers. As with any investment, digital transformation operations require understanding the investment need, managing risk, and making the necessary changes to reap the benefits of change. In addition, there are value gains that can be derived from existing investments. 3.
3. Leading the transformation and change from the top: Unless the digital business vision of senior executives is supported by top-down communication and governance within the organizational structure, it is difficult for digital transformation to become active and turn into action. The final step in guiding digital transformation is the process of senior executives leading the transformation and communicating and managing it to the organization.

Conclusion

Digitalization refers to the transformations that occur as a result of the adoption of information and communication technologies, which enable the production, processing, sharing, and transfer of information, by the decision-making mechanisms in the economy. Digital transformation is largely the result of telecommunication networks, computer technologies, operating systems, artificial intelligence, cloud computing, internet of things, etc. due to the widespread use of technologies.

Digital transformation, customer needs, and expectations in the company of new developments and opportunities. It consists of redesigning and transforming existing processes by reading well, and taking into account new technologies. Technological transformations have become a driving locomotive rather than a lever in achieving long-term business goals. Being in the future has become to some extent directly proportional to being in the digital world of the future. Whether they are individuals, businesses or institutions, they will be successful to the extent that they can realize the need for this transformation and make the necessary transformations on time, and they will gain a competitive advantage.

With the effects of the digital economy and digital age in today's businesses, the new search is to be "digital". In a number of industries, companies are dedicating resources to becoming digital companies to bring new products and access more information to digital technology to streamline their business processes. Businesses that cannot realize digitalization in their business models and designs, especially in production, will be doomed to disappear in the sector after a while.

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CHAPTER

Adoption and Success in the Digital Transformation of E-Tax Services: An Empirical Study

6

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Adoption and Success in the Digital Transformation of E-Tax Services: An Empirical Study[1]

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Introduction

Developments in information and communication technologies (ICTs) have transformed citizens' expectations in line with the information age. On the other hand, it has been observed that public administrations have made changes in the methods they use while performing public services. A large part of this change process consists of the electronic transformation of public administrations. Naturally, this process creates high costs for public administrations. However, considering the potential gains, it is observed that public administrations are willing to complete their electronic transformation. Nevertheless, the adoption and success of e-government investments, which create high costs for public institutions, emerge as a natural expectation.

The issue of the adoption and success of e-government applications is an important phenomenon in the literature. In this direction, the factors affecting the adoption and success of both information technologies in general and e-government applications in particular, have been frequently the subject of research in the relevant literature. In this context, the study focuses on the adoption and success of information systems, in particular e-tax services, which is a practice area of e-government. In the study, the Internet Tax Office (ITO) which represents e-tax services was determined as the object of examination.

In this context, under the title of "Theoretical Background", e-government, e-tax applications, and adoption theories and models are discussed, respectively. Again under this title, the Information Systems Success Model (ISSM), which was determined as a research model, was introduced. Under the title of "Literature Review", adoption and success studies focusing on e-tax services are included. In the section titled "Method", information about the research method is presented. Under the title of "Findings", the findings obtained as a result of the analysis were revealed, and under the title of "Discussion", the findings were compared with the literature. Finally, under the title of "Conclusion and Suggestions", it has been tried to reach generalizable results based on the findings and to develop suggestions that can be evaluated especially in terms of administration.

1 This study was produced from the master's thesis titled "Adoption and Success of E-Tax Services in Turkey: A Study on Interactive Tax Office Users in Bursa" of the first author.

Theoretical Background

E-Government, E-Tax, and Türkiye

It is not a new issue for governments to benefit from the opportunities provided by new technologies in administrative terms. Governments have used new technologies shaped according to the needs of the age and society for reasons such as the management system to improve, develop, and make it working and efficient. It is especially important for governments that want to compete with other governments in military, political and economic fields to develop or transfer new Technologies (Yildiz et al., 2012).

Today, the developments in ICTs and especially the widespread use of the internet have brought the relationship between public administration and technology to another dimension. On the other hand, the problems experienced by public administrations at the point of service delivery contributed to the strengthening of this relationship. In this context, with the use of ICTs in public administrations, there has been a transition to the e-government model, where public services are more effective and accessible, the governments can communicate more easily with all stakeholders, and administrative processes are improved (Sobaci, 2012).

Governments' policy-making on e-transformation coincides with the 1990s. In those years, the transformation efforts, which first started in the USA, were followed carefully by European countries towards the 2000s. Then, the eEurope Project, the first institutional initiative of the European Union for e-government, emerged. After 2000, the World Summit on the Information Society (WSIS) was organized by the United Nations and the International Telecommunication Union. At this summit, e-government was seen as an important stage in the transition to an information society (Demirel, 2004; Demirhan, 2011). Türkiye has also taken an important step towards the transition to e-government by participating in the "eEurope +" initiative, which includes candidate countries for the European Union (Ozlu, 2002; Sahin & Orselli, 2003). In the last twenty years in Türkiye, e-government has been tried to be disseminated throughout the country with many projects and applications. At this point, there are many e-government projects and applications that have been successfully implemented at the local and national level, especially the e-government gateway. In this context, e-tax services are also an important application area of e-government. E-Tax services provide convenience to administrations in many aspects, such as increasing taxpayer satisfaction, auditing and authorizing tax administration employees, optimizing transactions, and modernizing services. Due to these advantages, many projects and applications related to e-taxation have been developed in Türkiye. The most important of these projects and applications is the Tax Office Automation Project (TOAP), which is the first project realized in the field of e-tax in Türkiye. This project is also an important step in the development of other applications. TOAP is a three-stage project and at the end of the project, all tax offices are included in the automation system (Revenue Administration [GIB], 2021). With the completion of TOAP projects, many e-tax applications have been tried to be implemented rapidly in stages.One of the most important of these applications is the ITO application, which was determined as the object of examination in this study. Through ITO, which started to be used in 2018, all citizens can complete transactions such as accessing information about their tax records, paying taxes, verifying documents, making an application, and filing a petition online.

Adoption and Success Theories and Models

The development of a new technology may sometimes require bearing high costs and taking some risks to the future. The increase in the usage time of the developed technologies is one of the important elements that reduce the costs and risks. Therefore, the acceptance of technology by users and its long-term use may allow the development of new technologies, while not accepting it as the opposite may cause this technology to not be used again (Sharma & Mishra, 2014). In this sense, discovering the underlying causes of individuals' decision-making behavior is one of the subjects of interest for management information systems researchers (Compeau & Higgins, 1995; Hu et al., 1999; Mathieson, 1991).

In parallel, various adoption and success theories and models have been developed in order to investigate the factors that affect people's adoption behavior of a technology or technological product. In this direction, many theories and models have been developed that are referred to as general adoption theories and are included in the behavioral science literature. Prominent among these theories and models are the Diffusion of Innovation Theory, Theory of Reasoned Action, Social Cognitive Theory, and Theory of Planned Behavior (Cinar et al., 2018). These theories and models have also been used in the field of information technology, including e-government.

In the following periods, some theories and models have been developed in the relevant literature, focusing only on the adoption and success of information technologies. Some of these theories and models, such as the Technology Acceptance Model (TAM), Model of PC Utilization, Motivation Model, Technology Acceptance Model and Planned Behavior Theory Unified Model, Unified Theory of Acceptance and Use of Technology (UTAUT) and Information Systems Success Model (ISSM), are frequently used in the relevant literature (Cinar et al., 2018). Among these, ISSM differs from other theories and models in terms of being both a model of adoption and success. This model was developed by DeLone and McLean (1992) and updated in 2003. ISSM allows to measure the adoption of information systems with the use variable, and to measure the success of information systems with variables such as user satisfaction and net benefit. This model is the first and most widely used success model in the literature (Dorr et al., 2013; Nguyen et al., 2015; Urbach & Muller, 2012). In addition, the fact that the variables in ISSM consist of many sub-dimensions and that these sub-dimensions can vary according to the object of study makes this model a frame model (Gurses, 2021). ISSM consists of independent variables of system quality and information quality, and dependent variables of use, user satisfaction, individual impact and organizational impact. System quality in the model is a measure of the extent to which users can meet their needs by using the system's functionalities (convenience, system response time, flexibility, usability, etc.). Information quality is a measure of the extent to which the information provided by the system can meet the needs of users in terms of accuracy, completeness, relevance, etc (Chang et al., 2005; J. V. Chen et al., 2015; DeLone & McLean, 2003). Use, which is one of the dependent variables, is the degree and form of using the capabilities of the information system. User satisfaction is the level of satisfaction obtained by using the information system (Petter et al., 2013). Individual impact is the impact that using the information system has on individual performance (such as increase in job performance and in productivity, improvement in task effectiveness). Finally, organizational impact can be defined as the impact of using the information system on organizational performance (such as improvement in organizational effectiveness, efficiency, and profitability) (DeLone & McLean, 1992).

Accordingly, the technical success of the information system is measured by the system quality, the semantic success of the information system is measured by the information quality, and the success of being effective of the information system is measured by the use, user satisfaction, individual impact, and organizational impact.

After the first model, DeLone and McLean reconsidered the empirical studies made up to that time, made some changes to the model in 2003 (ISSM2), and added service quality to the model. On the other hand, individual impact and organizational impact variables in ISSM are expressed as net benefit variable in the new model (DeLone & McLean, 2003).

Literature Review: Adoption and Success Studies Focusing on E-Tax Services

In this part of the study, an extensive literature review on studies focusing on the adoption and success of e-tax services is included. As a result of the literature review, a total of 71 empirical studies focusing on the adoption or success of an e-tax service have been reached. When all these studies are evaluated together, it has been seen that the frequently used theory or models are UTAUT, TAM and ISSM. The first study to focus on the adoption or success of an e-tax service was done by Wang in 2002. In this study, the factors affecting the adoption of the e-filling system were tried to be explained with TAM. At this point, it can be said that the e-filling system is mostly determined as the object of examination in the studies. In this area, the users of the system are generally taxpayers and naturally, the sample in these studies mostly consists of this group.

Only 13 of these studies focus on the effect of an independent variable in ISSM and ISSM2 on a dependent variable in these models (see Table 1). In these studies, it is seen that the updated version of ISSM by DeLone and McLean in 2003 (ISSM2) is mostly used (Ali & Khan, 2010; C. W. Chen, 2010; J. V. Chen et al., 2015; Chumsombat, 2014; Floropoulos et al., 2010; Khayun & Ractham, 2011; Tjen et al., 2019; Zaidi, 2017). On the other hand, in some studies, it is observed that ISSM is integrated with models such as UTAUT (Andriani et al., 2017; Lu & Nguyen, 2016), TAM (Masunga et al., 2021), American Customer Satisfaction Index (ACSI) (Tran et al., 2020), and Expectation-Confirmation Model (ECM) (Veeramootoo et al., 2018). Again, in the mentioned studies, it is seen that variables such as trust (J. V. Chen et al., 2015; Khayun & Ractham, 2011; Tjen et al., 2019; Zaidi, 2017), reliability (Tran et al., 2020), previous experiences (J. V. Chen et al., 2015; Tjen et al., 2019; Zaidi, 2017) and risk perception (Veeramootoo et al., 2018) are included in the models as additional variables.

Table 1. E-Tax Adoption and Success Studies in the Axis of ISSM or ISSM2

Author(s), Year (A →Z)	Model	Additional Variable(s)	Object of Examination	Country	Sample
Ali & Khan (2010)	ISSM2	-	E-Tax Services	Switzerland	165 taxpayers
Andriani, Napitupulu, Haryaningsih (2017)	UTAUT, ISSM2	-	E-Filling	Indonesia	394 e-filling users
Chen (2010)	ISSM2	-	E-Filling	Taiwan	278 taxpayers

Chen, Jubilado, Capistrano, Yen (2015)	ISSM2	Previous experiences, trust in government, trust in technology, trust in e-government website	E-Filling	Philippines	234 e-filling users
Chumsombat (2014)	ISSM2	-	E-Filling	Thailand	415 taxpayers
Floropoulos, Spathis, Halvatzis, Tsipouridou (2010)	ISSM2	-	Taxation Information System	Greece	340 tax officers
Khayun & Ractham (2011)	ISSM2	Trust in e-Government websites, individual features	E-Excise Tax System	Thailand	77 company employees
Lu & Nguyen (2016)	UTAUT, ISSM2	-	E-Filling	Vietnam	137 professionals
Masunga, Mapesa, Mwakibete, Derefa, Myava, Kiria (2021)	ISSM2, TAM	-	E-Tax Services	Tanzania	313 taxpayers
Tjen, Indriani, Wicaksono (2019)	ISSM2	Perception of usefulness, previous experience, trust in government, trust in technology, trust in e-government website	E-Filling	Indonesia	1095 taxpayers
Tran, Nguyen, Nguyen, Do (2020)	ISSM2, ACSI	Organization complaints, organization satisfaction, organization expectation, responsiveness, reliability	E-Tax Services	Vietnam	230 professionals and company managers
Veeramootoo, Nunkoo, Dwivedi (2018)	ISSM2, ECM	Perception of risk, habit	E-Filling	Mauritius	645 taxpayers
Zaidi (2017)	ISSM2	Trust, effectiveness perception, e-government service quality perception	E-Tax Services	India	515 taxpayers

Method

Data Collection and Scale

The survey technique was used as a data collection tool in the research. The scale used in the study is based on the ISSM scale of DeLone and McLean (1992). The ISSM scale is a draft scale without questions/items. The questions in the scale are taken from Iivari's (2005) study focusing on the adoption and success of an information technology for municipalities. The questions were adapted to the ITO in a 7-point likert type. Accordingly, there are 38 questions in total, 8 questions regarding the demographic information of the participants and 30 questions under the system quality (SQ), information quality (IQ), use (U), user satisfaction (US) and individual impact (IM) factors.

Population and Sample

ITO is a system where taxpayers in Türkiye can get online services. With this, accounting professionals use this system more regularly and continuously than taxpayers. Therefore, it was thought that it would be more appropriate to apply this study on the adoption and success of the system to members of the accounting profession. However, it is very difficult to reach professional accountants working all over Türkiye. For this reason, the study is limited to accounting professionals operating in Bursa and using ITO. The number of accounting professionals determined as the population of the study can be found based on the data published on the website of the professional chamber. However, the number of accounting office personnel included in the population and who are system users cannot be determined in this way. For this reason, the sample size in the study was calculated with the $n= t^2.p.q/\alpha^2$ formula of Saruhan and Ozdemirci (Saruhan & Ozdemirci, 2018, p. 198), which is valid when the number of individuals in the population cannot be determined exactly. The survey form was prepared online and delivered to the participants according to the snowball sampling method. As a result, 294 survey forms suitable for analysis were obtained from the participants.

Research Model and Hypotheses

Iivari's (2005) model adapted from ISSM was used as a research model in the study (Figure 1).

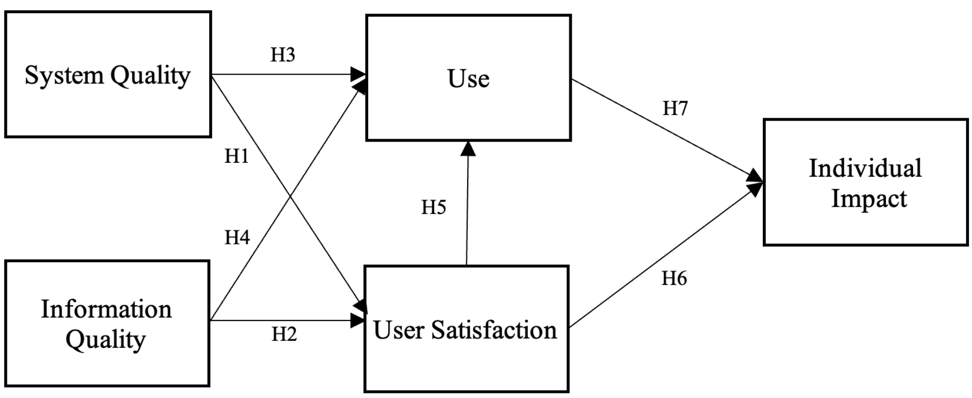

Figure 1. Research Model

Accordingly, the hypotheses to be tested within the scope of the research are as follows:

H1: There is a positive and significant relationship between system quality and user satisfaction.

H2: There is a positive and significant relationship between information quality and user satisfaction.

H3: There is a positive and significant relationship between system quality and use.

H4: There is a positive and significant relationship between information quality and use.

H5: There is a positive and significant relationship between user satisfaction and use.

H6: There is a positive and significant relationship between user satisfaction and individual impact.

H7: There is a positive and significant relationship between use and individual impact.

Data Analysis Method

The data obtained within the scope of the research were analyzed using SPSS 23 and AMOS 23 programs. At this point, first of all, descriptive statistics were applied to the relevant data. Afterwards, the validity of the measurement model was tested with confirmatory factor analysis, and the reliability of the model was tested with the cronbach alpha test. Before testing the hypothesis, it was checked whether the data were normally distributed, and finally, the relevant hypotheses were analyzed using the structural equation modeling method.

Results

Description of the Sample

In this section, descriptive statistics of demographic variables such as gender, age, education level, income level, profession and experience of the participants are included. Demographic information of the participants can be seen in Table 2 below.

Table 2. Demographic Information on Participants

		Frequency	Percent (%)			Frequency	Percent (%)
Gender	Female	138	46,9	**Profession**	Professional Accountant (PA)	32	10,9
	Male	156	53,1		Certified Public Accountant (CPA)	161	54,8
Age	18-24	30	10,2		Accounting Office Personnel (AOP)	101	34,4
	25-34	88	29,9	**Experience**	0-5 years	80	27,2
	35-44	104	35,4		6-10 years	45	15,3
	45-54	54	18,4		11-15 years	53	18,0
	55 +	18	6,1		16-20 years	47	16,0
Education	High School	18	6,1		20 years +	69	23,5
	Associate Degree	15	5,1	**Income**	Minimum Wage	46	15,6
	Graduate	225	76,5		Min. Wage-5.000 ₺	106	36,1
	Post Graduate	34	11,6		5.001 ₺ +	142	48,3
	PhD	2	,7	**Total**		**294**	**100**

When the table is examined, it is seen that the ratios of men (53%) and women (46.9%) participating in the research are close. In terms of age groups, it is understood that about two-thirds of them are in the age range of 25-44, and in terms of education level, about 90% of them have graduate and above education. On the other hand, more than half of the subjects (54.8%) work as CPA, 34% as AOP, and 10.9% as PA. When the professional experiences of the subjects are examined, it is seen that the subjects with professional experience of up to 5 years constitute the most crowded group with a rate of 27%. On the other hand, the rate of subjects with more than 10 years of professional experience is 57.5%. When the income levels of the participants are evaluated, it is understood that about half of the subjects (48.3%) have a monthly income of more than 5,000 ₺ and the rest of them have a monthly income below this amount.

Validation

Validity in the study was carried out by confirmatory factor analysis. Accordingly, a measurement model in accordance with the theory was created by using the AMOS program. Then, the goodness of fit values of the first model were examined. At this stage, it was seen that only the SRMR criterion was within the acceptable value range, and the other criteria were below the expected values. For this reason, modification indices were used to bring the current goodness-of-fit values to acceptable limits. Among the suggested items, covariance was defined by considering their theoretical relationships. Finally, it was seen that the goodness of fit values reached an acceptable level (see Table 3).

Table 3. Goodness of Fit Values

	CMIN/DF*	**CFI***	**TLI***	**IFI***	**SRMR***	**RMSEA***
Acceptance Values	≤ 3	≥ .90	≥ .90	≥ .90	≤ .10	≤ .08
First Model	3,336	,892	,881	,893	,0506	,089
Corrected Model	2,889	,914	,904	,914	,0532	,08

*CMIN/DF: Chi-square/Degree of Freedom, CFI: Comparative Fit Index, TLI: Turker-Lewis Index, IFI: Incremental Fit Index, SRMR: Standardized Root Mean Square Residual, RMSEA: Root Mean Square Error of Approximation

After the goodness of fit values of the measurement model reached the expected level, the factor loadings of the items were controlled. Table 4 shows the standardized regression coefficients. In CFA, these values represent factor loads. According to this, it is understood that all factor loads are above the acceptance limit of, 5 (Comrey & Lee, 2013, p. 243).

Table 4. Standardized Regression Coefficients

Item	**Coefficient**	**Item**	**Coefficient**
SQ1	,658	U2	,941
SQ2	,716	U3	,792
SQ3	,729	U4	,806
SQ4	,755	US1	,795
SQ5	,819	US2	,796
SQ6	,775	US3	,824
SQ7	,804	US4	,843
IQ1	,767	US5	,856

IQ2	,77	US6	,825
IQ3	,821	IM1	,858
IQ4	,886	IM2	,864
IQ5	,904	IM3	,927
IQ6	,864	IM4	,923
IQ7	,757	IM5	,874
U1	,966	IM6	,866

Reliability

After the validity analysis, Cronbach's Alpha test was applied to the items under the factors. The fact that the value reached as a result of the Cronbach's Alpha test is close to 1 indicates that the internal consistency of the items in the scale is high (George & Mallery, 2020, p. 236). In addition, Cronbach's Alpha test result greater than 0.7 indicates that the reliability of the relevant factor is at an acceptable level (Saruhan & Ozdemirci, 2018, p. 233). Table 5 shows the Cronbach's Alpha values of the factors in the scale. When the values are examined, it is seen that the Cronbach's Alpha values of all factors in the scale are above the expected level.

Table 5. Cronbach's Alpha Test Results

Factor Name	Number of Items	Cronbach's Alpha Value
System Quality	7	,899
Information Quality	7	,936
Use	4	,936
User Satisfaction	6	,929
Individual Impact	6	,956
Total	30	,964

Normality

The hypotheses within the scope of the study were tested with the structural equation modeling method. One of the assumptions of structural equation modeling is that the data show a normal distribution. Therefore, at this stage, it was checked whether the data were normally distributed. For this purpose, skewness and kurtosis values were checked. For a normal distribution, it is sufficient for the skewness and kurtosis values of the questions to be in the range of ± 2 (Garson, 2012, pp. 18–20; George & Mallery, 2016, p. 114). In this direction, the skewness and kurtosis values of the data in the study were examined. As a result of the analysis, it was seen that all values were within the range of ± 2. Therefore, it can be said that the data are normally distributed.

Testing the Structural Model

Under this heading, the structural model will be tested. Goodness-of-fit values of the structural model are given in Table 6. When the values of goodness of fit are examined, it is seen that all values are between acceptable values. Therefore, it can be said that the structural model is compatible with the data.

Table 6. Goodness of Fit Values of the Structural Model

	CMIN/ DF	CFI	TLI	IFI	SRMR	RMSEA
Acceptable Goodness of Fit Values	≤ 3	≥.90	≥.90	≥.90	≤ .10	≤ .08
Goodness of Fit Values of the Structural Model	2,890	,913	,904	,913	,0558	,080

After determining the compatibility of the structural model with the data, hypothesis tests were performed. While performing the hypothesis tests, the relationship between the factors (positivity and negativity) was checked and C.R. (Critical Ratio) values and p values were examined. In this context, hypotheses with a "p value" less than 0.05 and a "C.R. value" greater than 1.96 (if the relationship direction was also compatible) were supported. Accordingly, the results of hypothesis testing are given in Table 7.

Table 7. Hypothesis Test Results

Structural Relationships	Estimate	S.E.	C.R.	P	Result
H1: SQ → US	,669	,092	7,235	<0,001	**Supported**
H2: IQ → US	,194	,92	2,100	0,036	**Supported**
H3: SQ → U	-,418	,164	-2,556	0,011	Not Supported
H4: IQ → U	,368	,139	2,650	0,008	**Supported**
H5: US → U	,579	,129	4,502	<0,001	**Supported**
H6: US → IM	,506	,048	10,631	<0,001	**Supported**
H7: U → IM	,267	,037	7,191	<0,001	**Supported**

When Table 7 is examined, it is seen that system quality and information quality are in a positive and significant relationship with user satisfaction. Accordingly, H1 and H2 hypotheses were supported. From this table, it is seen that the most influential variable on user satisfaction is system quality with a CR value of 7,235. Although there is a significant relationship between system quality and use, it has been found that the direction of the relationship is negative. For this reason, H3 hypothesis was not supported. The relationship between information quality and user satisfaction with use is positive and significant. Therefore, H4 and H5 hypotheses were supported. In the context of these hypotheses, it is seen that the most influential factor on use is user satisfaction with a CR value of 4,502. Finally, it is seen that user satisfaction and use have a positive and significant effect on the individual impact. Accordingly, hypotheses H6 and H7 were supported. It was concluded that the factor affecting the individual impact factor the most was user satisfaction with a CR value of 10,631.

Discussion

In this section, a comparison of the findings obtained within the scope of the research with the literature is given. In this direction, the findings in the literature will be analyzed separately for each dependent variable in the model. As a result of the analysis, it was found that system quality (H1) and information quality (H2) had a positive and significant effect on user satisfaction. In most of the studies examining the effect of system quality and information quality on user satisfaction, similar results were obtained with this study (see for H1: Ali & Khan, 2010; Andriani et al., 2017; C. W. Chen, 2010; Chumsombat, 2014; Tjen et al., 2019; Veeramootoo et al., 2018; Zaidi, 2017 and for H2: Ali & Khan, 2010; Andriani et al., 2017; C. W. Chen, 2010; J. V. Chen et al., 2015; Chumsombat, 2014; Floropoulos et al., 2010; Khayun & Ractham, 2011; Tran et al., 2020; Zaidi, 2017). A small number of other studies (see for H1: J. V. Chen et al., 2015; Floropoulos et al., 2010; Khayun & Ractham, 2011, and for H2: Tjen et al., 2019; Veeramootoo et al., 2018) did not find a significant relationship. As a result of the hypothesis tests, the H3 hypothesis, which deals with the relationship between system quality and use, was not supported; H4 and H5 hypotheses, which deal with the relationship between information quality, user satisfaction and, use, respectively, were supported. When evaluated for the H3 hypothesis, it is understood that these findings do not agree with the findings of other studies in the literature (Ali & Khan, 2010; Khayun & Ractham, 2011; Lu & Nguyen, 2016; Zaidi, 2017). For the H4 hypothesis, in the studies of Lu and Nguyen (2016) and Zaidi (2017), a significant relationship was found between information quality and use, in line with the findings obtained from this study; in the studies of Ali and Khan (2010) and Khayun and Ractham (2011), no significant results were obtained in the relationship between these factors. In the context of the H5 hypothesis, the only study that can be identified on e-tax services in which the relationship between user satisfaction and use is examined in the relevant literature is the studies of Khayun and Ractham (2011). The findings of the study are consistent with our study. According to the findings of the study, it is understood that user satisfaction (H6) and use (H7) have a positive and significant effect on the individual impact. When the studies in the literature are examined, it has been found that user satisfaction (H6) has a significant effect on the individual impact factor (see Ali & Khan, 2010; J. V. Chen et al., 2015; Khayun & Ractham, 2011). However, only in the study of Tjen et al. (2019) no significant results could be reached. In the study of Ali and Khan (2010), the effect of use (H7) on the individual impact was found to be significant, but in the study of Khayun and Ractham (2011) no significant results were obtained in this relationship.

Conclusion and Recommendations

All of the economic units in the society are in some way related to taxational procedures. It is expected from different taxpayer groups (in terms of criteria such as sociocultural structure, education level, income level, age) to perform similar tax procedures. E-tax applications, which will be developed by using today's technologies, can make complex tax legislation simple and understandable, and also eliminate implementation differences between units. Tax revenues are the most important revenue item in the budget. In this direction, e-tax applications will facilitate the collection of taxes and will make significant contributions to the country's economy. In order to obtain these contributions and benefits, e-tax services must be successfully implemented. Especially the success of optional systems such as ITO depends on the extent to which taxpayers adopt this system. Ultimately, systems that are not accepted and used sufficiently by taxpayers will waste resources, even if they have a strong infrastructure. Therefore, in the study, the answer to the question "What are the factors affecting the adoption and success of ITO by taxpayers?" has been sought. Findings show that there is a positive and significant relationship between system quality and information quality with user satisfaction, information quality and user satisfaction with use, and finally use and user satisfaction with individual impact at the point of adoption and success of the ITO. At this point, it has been observed that the most influential factor on user satisfaction is system quality, and the most influential factor on use and individual impact is user satisfaction. In that case, the improvements to be made in the system quality and information quality of the ITO will increase the satisfaction of the taxpayers, and the taxpayers will use the system more. In addition, the increase in satisfaction and use levels will increase the benefit of taxpayers from the ITO system. The tax administration has brought a large number of e-tax services internally (G2E), externally (G2B, G2C), and inter-corporate (G2G) into use. In this respect, these initiatives of the administration also make important contributions to the development of e-government in our country. It is important to regularly follow the factors affecting the adoption and success of these applications from the perspective of users. At this point, the tax administration makes determinations about problems and solutions through satisfaction surveys and professional service procurement. However, it is thought that it would be more accurate to conduct these analyzes through personnel specialized in this field and with academic support when necessary. In this sense, it can be ensured that analysis units for e-tax services receive education on models focusing on the adoption and success of e-government. Thus, the failing aspects of the existing systems or the issues that negatively affect the use of taxpayers can be determined by scientific methods adoption and success of the system can be increased by making necessary improvements and it can be ensured that decision-makers can develop strategies for new applications.

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CHAPTER

7

5G and Beyond Networks for Digital Transformation: Opportunities and Productivity

Alperen EROGLU

5G and Beyond Networks for Digital Transformation: Opportunities and Productivity

Alperen EROGLU

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Introduction

With Industry 4.0, digitization is seen as the most potent factor that changes our lives substantially. Digital transformation will pioneer a change, combining the effects of various digital innovations that bring new structures, actors, values, practices, and beliefs that affect almost all life and fields such as ecosystems, organizations, businesses, industries, and cities (Kraus et al., 2021). Digital transformation leverages recent digital communication and information technologies such as mobile technology, analytics, social media, or embedded devices to drive significant business enhancements, including novel business models, contemporary operations, and improved customer experiences (Kraus et al., 2021).

Especially businesses can get maximum efficiency from digital transformation and eventually achieve significant operational gains by obtaining information, developing insights, and providing process automation using cloud-based artificial intelligence solutions, deep learning techniques, the Internet of Things (IoT) solutions, and other new digital paradigms (Maroufkhani et al., 2022). Considering all these changes and innovations, fast and secure connection technologies are critical in combining data from many software and hardware-based systems and devices. Current network infrastructures fail to support large numbers of users' significantly increasing demands. With its high bandwidth, mobility, ultra-low latency, high level of security, and reliability, 5G comes to life as a satisfied solution for businesses' digital transformation needs. With edge and cloud computing, an indispensable part of 5G, it will be possible to process vast amounts of data in real-time.

Few recent studies analyze 5G technologies' impacts on digital transformation. This chapter contributes to the literature by presenting a comprehensive study about how 5G and beyond communication technologies and other digital technologies impact the productivity of each other, in addition to considering various fields and industries from health to business. The rest of this chapter is structured as follows. In the successive section, the evolution of communication technologies is explained. Then, 5G and beyond networks are addressed as a paradigm shift, including how this technology works and crucial processes. This chapter also exhibits the impact of 5G and beyond technology on different technologies and industries. We analyze the opportunities and brings of 5G technology by considering the productivity of these digital and enabling systems.

Evolution from 1G to 6G

Approximately every ten years, it is observed that a new generation of wireless mobile telecommunication technology emerges. This evolution is characterized by new frequency bands, higher data rates, and new services one step closer to providing connectivity for our entire physical world (Guevara and Auat, 2020). Figure 1 shows the evolution of mobile communications in a timeline, highlighting the main features of each generation (Giordani et al., 2020). As illustrated in Figure 1, each of the generations is called 1G (First Generation), 2G (Second Generation), 3G (Third Generation) and 4G (Fourth Generation), 5G (Fifth Generation), and 6G (Sith Generation), respectively.

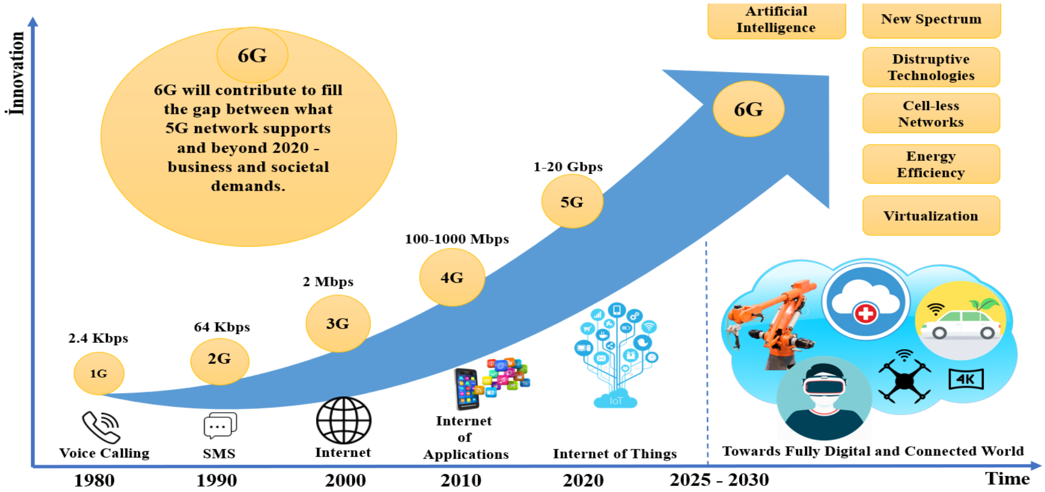

Figure 1. The evolution of cellular networks from 1G to 6G, with exemplary development, stand out for each generation (Giordani et al., 2020).

The first-generation networks emerged in the early 1980s. Although it has many limitations, it can transmit audio data in analog form. The most important limitation is that the low-quality sound is transmitted only in analog form (Elsayed et al., 2022; Guevara & Auat, 2020). Second-generation networks, which can be seen as a digitization step, were introduced in the late 1990s. Innovations in second-generation networks, which stand out with the increase in data capacity, improvements in sound quality, Short Message Data (SMS), Multimedia Message Service (MMS), Wireless Application Protocol (WAP), and Global System for Mobile Communications, were presented as digital services. There was also access to the Internet in 2G. 3G mobile networks introduced in the late 2000s have paved the way for high data transfer speed and wide-ranging Internet access, together with wireless access capability. It has pioneered many new mobile device applications such as the Global Positioning System (GPS), video conferencing, and e-mail access. In 2010, it was introduced as a technology based on the 4th generation network Internet Protocol, as a communication technology that provides high data rate and quality, low cost, and high security (Elsayed et al., 2022). 4G has enabled the ubiquitous high-speed wireless broadband currently used, enabling it to unlock the potential of mobile video and cloud services such as video games, high-definition mobile streaming, and immersive (3D) television. While the 4th generation communication networks support high data rates and low delays, it has also been the starting stage for the Internet of things. On the other hand, the 5th generation and later communication networks, the Internet in everywhere, and a completely interconnected digital world are envisaged. By 2020, 5G base stations have been deployed. The infrastructure has been created and used in some countries. On the other hand, beyond 5G networks, for example, 6G, it is foreseen to start in 2030 (Moubayed et al., 2022).

Why 5G is a Paradigm Shift?

5G is defined as the 5th generation mobile network. It emerges as a new global wireless standard after 1G, 2G, 3G, and 4G networks.

A new kind of network infrastructure is provided by 5G, which is designed to connect virtually everything and everyone, including objects, machines, and devices. The main objective of 5G technology is to provide an extensive network capacity, ultra-low latency, and higher data rates. The next-generation networks promise higher reliability, availability, and an improved user experience. Higher performance and increased efficiency assemble new industries while enforcing new user experiences (Attaran, 2021). The 5G era offers an innovative and disruptive communication infrastructure, as it brings network and service opportunities that were not available before. Beyond the conditions provided by the current 4G, the 5G networks which are highly mobile and dynamic, for example, even in very sparse or dense challenging situations, can provide continuity, higher data rate, lower latency, substantial simultaneous connections, and ubiquitousness. For instance, even in highly dynamic and densely populated areas such as stadiums, and shopping malls, it will be possible to provide enhanced service quality and meet user demands anywhere and anytime (Guevara & Auat, 2020). In addition, 5G will be a key enabler for an actual IoT application by providing a platform to connect large numbers of sensors and actuators with tight energy efficiency and transmission constraints (Sodhro et al., 2020).

Industry and academic studies, powered by this unprecedented growth, have marked the dawn of the 5G era in recent years due to the increasing number of connected devices, mobile data traffic, and the limitations of 4G technologies to meet the enormous data demand. It has focused on defining the features of 5G services with the following steps (Garcia-Roger et al., 2020). A device with 5G will be able to maintain its network connection anytime and anywhere and will have the ability to connect all devices in the network. To this end, the primary 5G system design is expected to support up to one million simultaneous connections per square kilometer and allow for the introduction of various emerging concepts in IoT services (Parikh and Basu, 2020). The IoT approach, which has become easier to implement with the implementation of 5G, is defined as a new digital communication paradigm in which daily life objects can communicate with each other and with users using the Internet. With this feature, it aims to expand and make the Internet concept more comprehensive by enabling easy interaction with a wide variety of devices such as 5G, IoT, home appliances, security cameras, industrial actuators, traffic lights, vehicles, and others. In this context, data is generated and collected from many connected devices. Integrating Cloud Computing and Big Data technologies play an essential role in processing different types of data according to requirements and creating more valuable services. Such technologies are crucial to enabling the IoT paradigm in urban scenarios known as smart cities. As communication networks are an indispensable element that continues exponentially today, they will always constitute the nervous system of new intelligent system paradigms. As the years' pass, the demands will be enormous. At this point, it will become essential for communication networks to transfer much more significant amounts of data at much higher speeds and lower latency. By advancing the work that has already begun for the trend of a fully connected world in 4G and 5G, sixth-generation connections, i.e., 6G mobile network, go beyond personalized communication and integrate not only humans but also vehicles, devices, computing resources, wearables, robots, sensors. It also offers an approach that connects all of them. 5G networks are already designed to operate at extremely high frequencies. However, with 6G networks, for example, terahertz and optical communication, higher spectrum technologies can benefit even more. It is also expected that 6G will bring intelligence to more efficient edge terminals where resources can be used distributive, thereby providing concrete application to distributed learning models that are studied from a theoretical perspective in the context of 5G. Unsupervised learning and knowledge sharing will support real-time network decisions much more intensely by predictive analytics with 6G (Du et al., 2020).

5G and beyond Networks: Characteristics and Opportunities

Because 5G and beyond networks' performance differs from the current systems due to higher bandwidth, lower latency, and seamless connectivity, it provides an advanced quality of service and experience so that users can access whatever and whenever they need.

Enhanced Mobile Broadband (eMBB), Massive Machine Type Communications (mMTC), and Ultra-reliable and low latency (uRLLC) communications are the most critical features of 5th generation wireless networks. Table 1 compares the 5G and beyond networks' essential features and characteristics.

Table 1. Key Characteristics of 5G and beyond network 6G

Key Features	5G	6G	References
Time Period	Now	Soon Probably 2030	(Ji et al., 2021) (Nakamura, 2020)
Carrier Bandwidth	Up to 100 MHz	Up to 400 MHz	(Nokia Bell Labs, 2021)
Number of Connected Devices	1 million devices per km^2	10 million devices per km^2	(Nakamura, 2020)
Mobility	Stringent, on-demand, flexible, >500 km/h	Seamless, >1000 km/h	(Siddiqui et al., 2022) (Alfoudi et al., 2019)(Ji et al., 2021)
Security	Cyberware and Critical Infrastructure Threats, SDN-NFV Threats, Cloud Computing related Threats	AI/ML based Intelligent Attacks, Zero-day attacks, Quantum Attacks, PHY Layer Attacks for VLC and THz, etc.	(Porambage et al., 2021) (Wang et al., 2020)
Ubiquitous	Partially	Fully	(Alraih et al., 2022)
Frequency	3 GHz–300 GHz	Up to 1 THz	(Alraih et al., 2022) (Ji et al., 2021)
Data rate	Up to 20 Gbps	Up to 1 Tbps	(Alraih et al., 2022) (Ji et al., 2021)
Latency	1 ms	10–100 µs	(Ji et al., 2021)
Spectrum (Available)	30 GHz	10–100 times higher than 5G	(Ji et al., 2021)
Spectral Efficiency	30 bps/Hz	100 bps/Hz	(Alraih et al., 2022)
Energy Efficiency	High	Ultra-high	(Alraih et al., 2022)
Connection density	10^6 (devices/km^2)	10^7 (devices/km^2)	(Ji et al., 2021)
Coverage	%99,99	%99,9999	(Alraih et al., 2022)
Precision for Positioning	Outdoor: 10 Meter	Outdoor: 1 meter Indoor: 10 Centimeter	(Ji et al., 2021) (Ahvar et al., 2021)
Integration for Satellite	Partial	Fully	(Alraih et al., 2022)
Integration for Automation	Partial	Fully	(Alraih et al., 2022)
Network awareness	Partial intelligibility	Ubiquitous intelligence	(Alraih et al., 2022)
Reliability	10^{-5}	10^{-9}	(Ji et al., 2021)

Key Features	5G	6G	References
Service Level	VR/AR/3D	Tactile	(Ahvar et al., 2021)
Extended Reality (XR)	Partial	Fully	(Alraih et al., 2022)
Haptic Communication	Partial	Fully	(Alraih et al., 2022)
Smart City Components	Segregated	Integrated	(Alraih et al., 2022)
Heterogenous Networks	Integration, Flexible	Fully Integration, Ultra-flexible	(Alraih et al., 2022)
Core Network	Internet of Things	Internet of Everything	(Alraih et al., 2022)
Usage Scenarios	Enhanced Mobile Broad Band (eMBB), Ultra-reliable Low Latency Communication (ulRLLC) and Massive Machine Type Communication (mMTC)	Ubiquitous mobile ultra-broadband (uMUB), Ultra-highspeed-with-low-latency communications (uHSLLC) and Ultrahigh data density (uHDD)	(Zong et al., 2019) (Dogra et al., 2020)
Standardization	5G/New Radio (NR)	No Standardization yet.	(Alraih et al., 2022)
Intelligent Reflecting Services	Not applicable	Yes	(Alraih et al., 2022)
Key Technologies	mmWave, mMIMO, UDN, SDN	THz, SM-MIMO, Laser and VLC, Quantum, Blockchain, AI/ML	(Nasir et al., 2021). (Dogra et al., 2020)
Flexible Spectrum	Flexible Duplex	Free Duplex	(Alraih et al., 2022)
Applications	AR/VR/360 videos, ultra-HD videos, Vehicle-2-Eveything (V2X), Internet of Things, Smart home/factory/city, tele-medicine, and wearable devices	Holographic, haptic, and tactile internet, full-sensory and extended-reality, fully autonomous driving, Industrial, Consumer, Enterprise Internet, Space travel, deep-sea sightseeing, Internet of Everything, and Internet of bio-nano-things	(Alraih et al., 2022). (Dogra et al., 2020) (Porambage et al., 2021)

How Does 5G Technology Drive Digital Transformation?

Digital transformation is defined as using digital technologies to satisfy growing needs, solve problems, provide the desired services, and identify the possible problems so that the developments in many fields can continue following technology requirements. At this point, the fifth generation and beyond wireless networks have vital importance, and they are included as a part of the promised solutions. Of course, there will be potential problems brought by every technology, such as application and dissemination, compatibility of installation and development stages, as in the establishment and spread of the infrastructure of 5G and beyond networks (Zakeri et al., 2020). In addition, technological innovations such as software-defined networks, slicing, virtualization of network functions, and cloud-based platforms will force users and service providers to take different approaches and acquire new solution methods and skills (HPE, 2018). This section analyzes how 5G affects digital technologies, which are indispensable elements of digital transformation, and which features come to the fore in these effects. This section also presents the prominent effects of 5G and beyond networks in different fields and industries; in addition, the key features that can drive these effects are discussed in detail.

Impact of 5G and beyond Technology and Different Digital Enabling Technologies: Productivity

In this section, we reveal a strong relationship between 5G and beyond networks and some of the new digital innovations and technologies. Some of them are Artificial Intelligence, Big Data, Machine Learning, Internet of Things, Cloud Computing, Edge Computing, Blockchain, network slicing, virtualization including software-defined networks and network function virtualization, Tactile Internet, Virtual Reality, and Augmented Reality, as illustrated in Table 2. These technologies are essential for implementing digital transformation, which is connected and interrelated with 5G and beyond networks. We discuss the impacts of these technologies on each other by emphasizing the productivity of these technologies. All these technologies are the backbones of the digital transformation era. 5G and beyond networks provide an enhanced communication infrastructure; the other mentioned technologies in Table 2 also impact 5G and beyond networks, significantly accelerating the deployment and spreading of 5G network systems.

Table 2. Impact of 5G Networks and Digital Technologies on each other: Productivity

Digital Technology or Approach	**Distinctive and key Features or Characteristics for Productivity**	**Impact of 5G Networks and Digital Technologies on each other: + How they increase their productivity?**	**References**
Artificial Intelligence (AI) + Big Data + Machine Learning (ML) + Deep Learning (DL)	Higher bandwidth Secure data Greater data rate Reliability Secure connection High throughput	• 5G enables more speed data analysis in real-time for AI • AI can provide an intrusion detection system for 5G networks • AI can optimize 5G spectrum allocation • AI makes 5G networks proactive and predictive • ML provides 5G networks with predictiveness and proactiveness • AI/ML/DL and Big Data make the base stations (BSs) intelligent so that BSs can make their on decisions network management. • AI/ML/DL and Big Data make 5G networks self-adaptive and self-configurable so that dynamic configurations can be done in real-time depending on processed and analyzed data. • All these opportunities enhance future networks' characteristics such as reliability, latency, and efficiency	(Bansal et al., 2021) (Franchi et al., 2021) (Sairete et al., 2021) (Zhu et al., 2019) (Nguyen et al., 2022) (Mahmoudand Ismail, 2020) (Nekovee, 2022) (Asghar et al., 2022)
Internet of Things	Ubiquitous Connectivity Wide Coverage High Capacity Higher speed of data transmission Reliability Low latency	• 5G accelerates Internet of Things applications • With 5G IoT devices can share their massive data faster, • Integration of 5G networks and IoT solutions enable the realization of various smart city and fully autonomous connected vehicle applications, • Upcoming technology results in significantly increasing IoT devices, forcing the rapid deployment and spreading of 5G network infrastructure.	(Khuntia et al., 2021) (Sun and Ji, 2022) (Chen et al., 2020) (Nasir et al., 2020) (Asghar et al., 2022)

Digital Technology or Approach	Distinctive and key Features or Characteristics for Productivity	Impact of 5G Networks and Digital Technologies on each other: + How they increase their productivity?	References
Internet of Everything	Fully Connectivity Seamless Connectivity Wide Coverage High Capacity Reliability Low latency Higher speed of data transmission	• With the realization of the Internet of Everything paradigm, all devices in a 6G network can communicate. • 6G and beyond networks will realize the IoE paradigm. • The future networks and IoE lift the fully autonomous and connected vehicles and massive machine-type communication in addition to communication among people, infrastructure, and other objects.	(Sah et al., 2022) (Ahmad and Srivastava, 2022) (Asghar et al., 2022) (Chen et al., 2020) (Nasir et al., 2020)
Cloud Computing	Low latency Reliability Seamless Connectivity	• 5G and beyond networks promote major enhancements on this technology. With the future networks, cloud computing has become faster, more reliable, and more efficient, in addition to better synchronized cloud services. • To manage the enormous traffic that arises from billions of nodes and to realize new processing-intensive 5G applications. Therefore, the existing network structure must be transformed as soon as possible, and the networks must provide higher speed, lower latency, and more capacity. Cloud technology accelerates the realization of this new network infrastructure and characteristics because it forms the basis of customer experiences, product services, and business efficiency.	(Asghar et al., 2022) (Nekovee, 2022) (Ahvar et al., 2021) (Barakabitze et al., 2020)
Distributed Mobile Edge Computing	Wide coverage Real-time access Energy Efficiency	• Distributed Mobile Edge Computing is useful for 6G and beyond networks to avoid centralized solutions.	(Asghar et al., 2022)
Multi-access Edge Computing	Ultra low latency Higher bandwidth Real-time access Energy efficiency	• 5G and beyond networks benefit from MEC abilities to access resources required to achieve optimum performance. • MEC utilizes the 5G and beyond networks opportunities such as network function virtualization, network slicing and software-defined networking.	(Asghar et al., 2022) (Ahvar et al., 2021) (Barakabitze et al., 2020)
Network Slicing	High capacity Highly secure Reliability	• Slicing is a critical feature of 5G networks. • It facilitates the implementation of virtual networks based on 5G. • 5G networks can be divided into subnets with different priorities, so isolation from other networks is possible.	(Nekovee, 2022) (Barakabitze et al., 2020)

Digital Technology or Approach	Distinctive and key Features or Characteristics for Productivity	Impact of 5G Networks and Digital Technologies on each other: + How they increase their productivity?	References
Software-defined Networks + Network Function Virtualization	High data transmission, Improved spectral efficiency, optimized resource allocation	• SDN, a programmable paradigm, enables the controlling of the data flow in 5G and beyond networks. It separates the control plane from the data plane. It makes the network more flexible, dynamic, manageable, and remotely controllable. • SDN and NFV are two of the key enabling technologies of 5G networks. • NFV allows network slicing and distributed cloud approaches. • Thanks to NFV, 5G network functions can be allocated dynamically and deployed easily. • NFV also decreases the capital expenditure (CAPEX) and operational expenditure (OPEX) for a network where users have increased demands by utilizing cost-efficient dynamic network infrastructure.	(Asghar et al., 2022) (Tayyaba et al., 2017) (Siriwardhana et al., 2021) (Syed-Yusof et al., 2020) (Asghar et al., 2022) (Barakabitze et al., 2020)
Tactile Internet (TI)	High availability Highly secure Ultra-low latency	• TI is high technology benefits from 5G and beyond networks to allow interactive communication between two tactile edges in real-time with haptic data.	(Dutta and Hammad, 2020) (Mourtzis et al., 2021) (Fanibhare et al., 2021)
Augmented Reality + Virtual Reality	High bandwidth Low latency Higher speed of data transmission High throughput	• AR and VR will be distinctive and main applications for 5G and beyond networks, • 5G enables realistic services for AR, • 5G provides users with a better experience for AR, • With 5G, users can utilize VR content whenever and wherever they need it.	(Chen et al., 2020) (Mihaljević et al., 2021)
Extended Reality	High bandwidth Low latency Higher speed of data transmission High throughput Seamless connectivity	• Extended Reality, including augmented reality, virtual reality, and mixed reality can fully be realized with the 5G beyond networks, especially 6G.	(Asghar et al., 2022) (Siriwardhana et al., 2021)
Blockchain	Low latency Higher bandwidth Real-time access Higher speed of data transmissions	• Blockchain is a candidate solution to make 5G and beyond networks, including billions of devices, more secure and decentralized. It makes the network and operations decentralized, transparent, immutable, non-repudiation, and resilient to cyber-attacks. • With the key features of 5G and beyond networks, Blockchain operations and applications become faster so that real-time transactions are reliably performed.	(Asghar et al., 2022) (Fanibhare et al., 2021)

Digital Technology or Approach	Distinctive and key Features or Characteristics for Productivity	Impact of 5G Networks and Digital Technologies on each other: + How they increase their productivity?	References
In addition to the above-enabling technologies and approaches, there are other technologies in which 5G provides opportunities with its key features such as low latency, higher bandwidth, higher data rate, security, and reliability: Digital Twin, Human Machine Interaction, Industrial Internet, Critical Communication and Infrastructure, 3D printing, Mobile Robots, Sensors, Customer Relationship Management (CRM).			(Nguyen et al., 2022) (Maroufkhani et al., 2022) (Carvalho et al., 2020)

Impact of 5G and beyond Technology on Different Digital Industries and Fields: Productivity

The 5G mobile communications drive network services in different industries, such as transport, retail, medicine, and security; therefore, it accelerates the digital transformation of vertical services. Table 3 presents the impact of 5G and beyond networks on different digital technologies by stressing their productivity gains. This section also explains the detailed analysis of each industry.

Table 3. Impact of 5G and beyond networks on Different Industries in terms of productivity

Digital Industry/ Field	Impact of 5G and beyond networks on Different Industries Productivity	References
Healthcare	• Efficient data processing, • Larger accessibility • Remote control • Mobile remote care • Easily applied telehealth, telesurgery, pharmacy, and telemedicine • Wearable technology	(Attaran, 2021) (Attaran M. & Attaran S., 2020) (Siriwardhana et al., 2021) (Maroufkhani et al., 2022)
Telemetry	• Real-time communication • Internet of anywhere • Higher spectrum availability	(Attaran M. & Attaran S., 2020) (Marin, 2020) (Sampson, 2019) (Giannopoulos et al., 2021)

Digital Industry/ Field	**Impact of 5G and beyond networks on Different Industries Productivity**	**References**
Remote Control	• Speed, safe, and efficient remote management • Transmission of huge data, • Greater number of remotely controllable devices • More accurate responses	(Attaran M. & Attaran S., 2020) (Groshev et al., 2021) (Rao and Prasad, 2018) (Mendoza et al., 2021)
Intelligent Transportation	• Safe, highly mobile, comfortable driving and traffic rules • Vehicular Communication: Vehicle-to-Everything • Automotive: Autonomous vehicles (From no automation to fully autonomation), Tele-operated Driving • Road Safety (Pedestrian, Intersection, Driver Safety) • Intelligent Navigation • Large filed and high definition (video, image, voice) media downloading • Smart Public Transport • Connected Vehicles: Interoperable connectivity • Quantum and Blockchain technologies-based transportation	(Alalewi et al., 2021) (Adhikari et al., 2021) (Attaran M. & Attaran S., 2020) (Monserrat et al., 2020) (Guevara and Auat, 2020) (Hamalainen, 2021) (Porambage et al., 2021) (Balkus et al., 2022) (Joshi H. & Joshi S., 2022)
Logistic	• Increasing the number of connected vehicles for land, sea, and air, • Enhancing logistic management • Reducing operational costs, • Green applications, • Complete delivery, • Increase in productivity	(Monserrat et al., 2020) (Maroufkhani et al., 2022)
Agriculture/Farming	• Real-time data and monitoring, • High-definition video streaming, • UAV/Drone and mobile robot-assisted smart farming, • Usage of digital assistive technologies such as Cloud Computing, Edge Computing, AR, and VR • Enhanced (IoT) connectivity: a massive number of sensors • Remote controlling and monitoring	(Tang et al., 2021) (Attaran M. & Attaran S., 2020)
Public-Safety	• Obtaining accurate and reliable data • Faster emergency response • Enhancing the quality of communications to make coordination for response teams. • Video Surveillance and analytics • Intersection and Pedestrian Safety • Traffic management	(Attaran M. & Attaran S., 2020) (Tealab et al., 2020) (Quinn, 2020) (Gomez-Barquero et al., 2020) (Joshi H. and Joshi S., 2022) (Maroufkhani et al., 2022)

Digital Industry/ Field	Impact of 5G and beyond networks on Different Industries Productivity	References
Education	• Digital Learning • Distance Learning • Increase availability of education • Equal opportunities for education • AR as a new educational model • Digitized and Digital Medical and employee education: Distance and Online Learning (AR/VR/3D Videos)	(Attaran M. & Attaran S., 2020) (Nakao, 2020) (Morimoto et al., 2022) (Xu et al., 2020) (Joshi H. and Joshi S., 2022) (Maroufkhani et al., 2022)
Smart Cities and Intelligent Buildings	• Smart air conditioning • Intelligent Elevators, • Smart Ventilation, heating • Intelligent Traffic Management: Intelligent Navigation and Routing • Smart Transportation, Healthcare, Education, Governance • Intelligent and digital urban planning: Efficient Energy Distribution • Green Infrastructure • Fully connected environment	(HPE, 2018) (Tealab et al., 2020) (Rusti et al., 2019) (Ahrend et al., 2019) (Joshi H. and Joshi S., 2022) (Gohar and Nencioni, 2021) (Turkalj, 2021)
Retailing	• Heavy-duty big data predictive analytics • Customization • Augmented store experiences using AR/VR/XR • Optimized Intelligent logistics and operations in the store	(Attaran M. & Attaran S., 2020) (Maroufkhani et al., 2022) (Hitachi solutions, 2022)
Manufacturing	• Enhanced Machine type communication, • Seamless and fully connectivity • Automation • Smart production, factory • Performing Internet of Things applications • Agile manufacturing • Improved Business Intelligence	(Attaran M. & Attaran S., 2020) (HPE, 2018) (Lundgren et al., 2022) (Nguyen et al., 2022) (Wang and Gao, 2020) (Kerroum et al., 2020)
Financial Sector	• Highly secure and reliable platforms • Cost-effective customer processes • Mobile and online applications for customer transactions • Personalized financial responses • Digital Banking • Automation • Robotizing • Digital investment recommendation applications	(Szasz and Varga, 2022) (Lee et al., 2021) (Garcia, 2021) (Agafonova et al., 2021) (Seow et al., 2021)

Digital Industry/ Field	Impact of 5G and beyond networks on Different Industries Productivity	References
Media and Entertainment • Evolutionary consumer and media interaction: Virtual Reality • Capability for Big Data processing and analytics • Dynamic and real-time responses to significantly increased demands • Enhanced quality of service • High-speed downloading and uploading • Highly interactive and embracing meetings: Game streaming • Evolved digital content offered by different platforms: 4K/8K displays, 3D/4D videos, high-speed voice • Seamless and Ubiquitous Connectivity • (Attaran M. & Attaran S., 2020) • (HPE, 2018) • (Guarda et al., 2021) • (Turkalj, 2021)		
Smart Grids	• Efficient edge computing solutions • 5G connectivity • 5G distributed network infrastructure • Less bandwidth requirement and minimum latency • Highly secure 5G-enabled smart grids • Efficient distributed smart grids	(Chen et al., 2021) (Borgaonkar et al., 2021) (Sun, 2021) (Han et al., 2022)
Utilities and Energy	• Less energy consumption • Backward compatibility • Processing Big Data • Remote monitoring and controlling • Efficient smart grid solutions • Edge Computing Ability	(Attaran M. & Attaran S., 2020) (Tealab et al., 2020) (Ahrend et al., 2019) (Dutta and Hammat, 2020) (Turkalj, 2021) (Shunxin et al., 2020) (Gustavsson et al., 2021)

Healthcare

The health sector highly affected by digital transformation is rapidly developing today. This process gains even more speed, especially with what 5G and beyond networks provide. Here we can list some of them as follows:

- It allows efficient, reliable, and effective collection, storage, and instant processing of patient data produced in huge sizes.
- With the rapid processing of critical medical data, information can be sent to end users, for example, to a mobile application. It can provide real-time action to take new action with suggestion systems.
- It makes the digital medical systems widely accessible.
- It facilitates the control of remote devices in various operations.

- It allows utilizing wearable technology to prevent and control diseases.
- By enabling the use of virtual and augmented reality technology and effective remote management, it also paves the way for distance education. It facilitates the reproducibility and accessibility of the training provided.
- Telehealth, telenursing, telesurgery, and pharmacy are important digital health services, and 5G plays a significant role in implementing them.

Telemetry

Telemetry is defined as an automated system consisting of a control unit, physical input, and a communication channel, which is a remote measurement process to make data transfer possible between receiving devices and remote locations (Marin, 2020). Since 5G and beyond networks tend to enable communication anywhere between anything, it facilitates the usage of telemetry as a remote automated system. In addition, real-time monitoring and communication are easily applicable because 5G and beyond networks enhance the spectrum and provide seamless and full connectivity (Sampson, 2019).

Remote Control

Technological enhancements and new paradigms such as 5G networks, the Internet of things, and Industry 4.0 all over the world increase the remote-control necessity. Recently, especially after the COVID-19 Pandemic, industries have begun to utilize remote control heavily. Digital transformation in the remote control is considered obviously because of increasing sector/industry/user demands and the number of automated machines. Since 5G and beyond networks provide higher bandwidth and lower latency with more reliability and safety, the intensive data and a massive number of machines, industries/sectors /users can perform remote control very fast and efficiently.

Intelligent Transportation

With a fully digital connected world paradigm which 6G networks suggest, some technological innovations such as automotive, Vehicle-to-Everything (V2X), highly available Smart Public Transportation, which have optimized routes and fleets, and Connected Vehicles are key applications of the digital transformation in the transportation sector. Each of the features of 5G and beyond networks will contribute to the digital transformation of applications in transportation. At this point, it is possible to classify these contributions in three parts:

- Improvements in the connectivity of vehicles with each other and other objects that already exist will go much further,
- Increases in the ubiquity of interconnected vehicles and devices,
- Enhanced data availability to manage and operate the transportation issues.

In addition, 5G, 6G, and beyond network-based applications and improvements are critical for transportation systems such as Artificial Intelligent, High Mobility, Interoperable Connectivity, Quantum Computing and Communication, Blockchain-based information management and sharing.

Logistic

Logistics is another sector that is as important as the transportation sector. In this sector, 5G and beyond networks offer new solutions that can be classified into three categories to produce efficient solutions. To make the autonomous vehicle paradigm widespread for sea and air as well as on land, to increase the number of connected vehicles by reducing the cost by making communication between vehicles effective and efficient, to reduce costs and environmental pollution by reducing energy consumption. These approaches aim to facilitate logistics management and product tracking, monitor the infrastructure, and ultimately increase overall productivity.

Agriculture/Farming

Smart agriculture can be defined as the ability to obtain more and better-quality products in a short time and at the most affordable cost by using digital technologies. In smart agriculture, with 5G's features such as device density, ultra-low latency, ultra-reliability, and security, with the ability to instantly process real-time data from thousands of IoT devices, as well as with video streams transferred from unmanned aerial vehicles or mobile robots, effective data analytics can be done (Tang et al., 2021).

Public-Safety

5G and beyond networks can widely provide many smart city applications for public safety, such as video surveillance, pedestrian and intersection safety, and traffic management based on some key technologies including artificial intelligence, big data, and the Internet of Things to make accurate and fast monitoring, biometrics for access control, broadband communications, and mobile applications. 5G and beyond networks enhance the response times for emergencies such as disasters, so a real-time reaction and monitoring system can be used.

Education

With 5G and beyond networks, Digital Learning and Distance Learning opportunities have become increasingly widespread. Any education opportunities can now be easily accessible by every student or everyone. These developments provide an applicable education with equal opportunity. In addition, augmented reality as a new educational model can be easily used in courses and training.

Smart Cities and Intelligent Buildings

A smart city is a digital urban area consisting of information and communication technologies such as sensors, intelligent devices, and real-time data collected using digital and electronic methods. Different algorithms process the collected data by using edge and cloud technologies. This information is utilized to manage smart city applications such as smart transportation, traffic management, navigation, smart air-conditioning, and smart education. Smart city applications consider energy efficiency, so any action may consume less energy. Thanks to the infrastructure suggested by 5G and beyond networks, a fully connected world is possible in a smart city where people and everything are connected. One of the most critical objectives of digital transformation for any smart city is to make the life quality of the tenants' and residents' life better so that the productivity of their life increases.

Retailing

Digital transformation of the retail sector can be divided into four parts such as customer participation, worker empowerment, optimized operations, and designing a brand-new customer product. Since 5G and beyond networks provide high-speed data, predictive analytics is performed using Artificial Intelligence and Machine Learning techniques. Retail digital transformation powered by big data analytics aims for customer satisfaction, creating new products based on customer demands collected via following the customer behaviors and shopping patterns. With AR/VR/XR applications that are much more efficient with 5G and beyond networks, store experiences such as analyzing different scenarios responses, worker empowerment, and monitoring store operations can be improved.

Manufacturing

With the 5G-based digital transformation applications, the factories and workplaces can optimize the production and sale costs and manage the production process that is always desired to be agile. In an intelligent factory with 5G and beyond infrastructure, the production process and the operations can be monitored and controlled in real-time by gathering and processing all connected IoT devices and their communications.

Financial Sector

5G and beyond networks increase the data transmission efficiency, enable connection for many devices by providing high bandwidth and low latency, and allow real-time communication. With these characteristics offered by 5G and beyond networks, the digital economy and digital finance sector have become safer and more efficient. Especially the concept of digital banks and digital transformation in finance have made and will make severe progress with the automation of transactions and their independence from human errors. It has also increased the reliability of digital applications by managing transactions in real-time, very quickly and reliably. The understanding of banking and investment has changed with this transformation. With the rapid performance of big data analytics offered by 5G and beyond networks that facilitate this transformation in addition to cloud computation, investment recommendations can now be made with intelligent applications.

Media and Entertainment

5G and beyond networks make an evolutionary media and entertainment experience possible with high-speed data transmission and lower latency, 3D/4D videos, 4K/8K displays, and high-speed voice. With the opportunity of 5G and beyond network connectivity, users can access their desired content anywhere and whenever they need it. Since Big data belonging to millions of users can be analyzed, platforms can recommend content based on users' profiles. Because of the high-speed streaming capability of 5G and beyond networks, higher interactive meetings are possible.

Smart Grids

Smart Grid can be defined as a digital technology that is an electricity network allowing for two-way communication. Along the transmission lines, sensing capability makes the grid technology smart. Recently, this technology has suffered from coverage problems because of scattered distribution and a massive number of nodes. This problem sometimes results in a barrier problem for grid operations. 5G and beyond networks can overcome this challenge by enabling the deployment of edge nodes that are served by terminal access networks. With the network slicing ability of 5G, smart grids can be logically divided into isolated networks so that different parts can serve with better coverage. With the implementation of edge computing, 5G makes the gateway deployment distributed so that local traffic can be processed by reducing the bandwidth requirement and latency. With 5G security solutions, the smart grid provides a more secure service.

Utilities and Energy

With the rapid technological improvements, user and city demands are significantly increasing. Researchers focus on using 5G and beyond network capabilities to develop energy-efficient solutions, lessen energy consumption, and diminish carbon emissions. The most recent technologies can be integrated with the existing infrastructures when the digital transformation is performed. 5G applications such as network slicing and edge computing can lessen energy consumption. Since 5G has high-speed data transmission and low latency, large volumes of data can be processed concisely to reduce energy consumption.

How does 5G-enabled Digital Transformation Affect Business Productivity?

Digital transformation has paved the way for new approaches and unconventional solutions to emerge or become more widespread in business and industry, especially with the effect of the COVID-19 pandemic. For example, the digital transformation of workplaces has brought evident innovation and change. The way of remote working is at the forefront of this change. To increase the productivity of their employees, employers can now take steps such as increasing the employee's commitment to the workplace and his/her job, ensuring the fastest access to the data he/she needs, sharing the results obtained in the fastest way, with the conveniences brought by the new generation networks, regardless of location, freely chosen. They try to earn their employees with platforms. At this point, there is a need for mobile-oriented, real-time, collaborative solutions to increase employees' productivity. 5G and beyond networks provide the necessary communication technologies infrastructure at this point. With the technological developments in recent years, workplace change has evolved from analog solutions to digital solutions. In addition, the pandemic also affected this change with positive momentum. In this way, workplaces had to keep up with this trend to meet market demands, increase work and worker productivity, and maintain a strong presence in the market. Employees can now use more mobile applications, especially with the benefits of 5th generation networks, and they can monitor their work and performance thanks to these mobile applications. In addition, to provide real-time solutions, the video conferencing method, for example, has been widely used as a suitable solution to ensure communication between employees and business continuity. The ability to access fast data anytime and the working principle anywhere will become even stronger with the spread of 5G. Let us look at a few situations where 5G and beyond communication networks will provide us and affect productivity in the business world as presented in Table 4:

Table 4. 5G and Beyond Networks-Enabled Business Management and Productivity

Most Prominent Enabler - 5G and beyond Characteristics	**Enabler – Digital Technology or Approach**	**How affects Productivity**
Low latency High speed date rate Reliability	• Augmented Reality • Virtual Reality • Distance management • High quality Video Streaming	5G and beyond networks provide more bandwidth and low latency so that users can access and send the data faster. Video conference systems and augmented reality, the next-generation networks' features, provide an essential concept for anyone to consider anywhere as their office via these opportunities. Information management becomes more and more easily thanks to these possibilities.
High bandwidth High connection density High throughput	• Business Intelligence • Automation • Smart Interactions	5G and beyond networks facilitate new solutions, including intelligent conference systems, artificial intelligence approaches, and office and workplace automation so that maximum productivity of a workplace can be achievable.
Ubiquitous connectivity Increased network energy efficiency High connection density High throughput	• Virtual reality, augmented reality, extended reality • Cloud technology and edge computing	In a digital workplace supported by 5G and beyond, it is inevitable that the work plan of employees should be made according to remote working and flexible working models, collaborative communication and workplace opportunities, and connection with any person or object anywhere, anytime. While 5G and beyond will do this, they will do so by enabling almost real-time and ubiquitous connectivity with possibilities such as virtual reality, augmented reality, extended reality. It also makes distributed workforce possible with new technologies such as cloud and edge computing. Combining all these possibilities means it will have severe productivity-enhancing effects in the business world.
Decreased latency Improved spectral efficiency	• Shared resources • Synchronization • Remote access • Real-time video interaction	Thanks to the 5G and beyond communication networks, it is possible to provide access by sharing enormous processing power using Cloud technology and with the real-time synchronization approach. By providing real-time video interaction, 5G enables remote problem solving, business meetings, and conferences and enables businesses to reduce operational costs with these facilities.
Fully connectivity Increased network energy efficiency High throughput	• Fully autonomous • Smart Systems • Energy Efficiency • Public Safety	The concept of the Internet of Things, which was started to be implemented with 4G, and the adoption of a fully connected and digital world approach with 5G and beyond, helps smart technologies such as smart buildings, smart transportation, smart agriculture, and many more. There is an expectation to support fully autonomous approaches in similar areas, which will bring many benefits. For example, 5G and beyond networks, one of the crucial pillars in the implementation of autonomous and connected vehicle technology, will contribute to reducing traffic accidents, reducing fuel consumption, and allowing drivers to spare more time for themselves to increase efficiency.
Higher speed and bandwidth	• Interactive Communications	Thanks to 5G and beyond networks, employees' communication with each other and customers in smart buildings and workplaces have become highly interactive.

Now let us examine the productivity gains of 5G and beyond networks in another area, namely the industry. Digital transformation in the industry is an inevitable reality behind it; many reasons are similar and different to the business world. Among these, there are factors such as increasing income by providing better service to the sector, increasing efficiency and effectiveness by reducing production, sales, and marketing costs, on the other hand, trying to survive in the competitive environment to stay in the market and even being a pioneer, while preventing risks by increasing security.

Conclusion

The rapid advancement of technology and the ever-increasing growth of the needs of users who use many state-of-the-art products have rendered the existing communication and network technologies inadequate. Not only mobile users but also the business world, health sector, automotive, intelligent transportation, logistics, education, smart urbanization, retailing, production and manufacturing sector, finance sector, media and advertising, intelligent networks, and digital learning have significantly increased demands. In the face of emerging these needs and increasing demands, 5G and beyond networks have been developed to create not only technological innovation but also a paradigm shift, and especially 5G networks have started to be used as of 2020. This chapter explains how 5G affects productivity in the sectors mentioned above and areas. In addition, digital and disruptive technologies and approaches are known as enabling technologies in the digital age, such as artificial intelligence, deep learning, machine learning, big data, distributed mobile edge computing, multi-access edge computing, network slicing, virtualization of network functions, haptic internet, augmented and virtual reality. , advanced reality, blockchain, digital twin, and many other technologies were examined in a way that considers the aspects that increase the efficiency of the relationship between 5G. Finally, the efficiency of 5G in the business world, which is the most effective and can be changed by the next-generation networks, is discussed. In particular, the characteristics of 5G networks such as low latency, high bandwidth, high spectral efficiency, fast data transmission, high reliability, and security are considered accelerator and problem-solving paradigms for the above-mentioned digital approaches and technologies. While 5G networks have started to be deployed worldwide and various standards are being established, the implementation of 6G networks will coincide with the year 2030. With 5G, the concept of the Internet of Things will be implemented much more efficiently, and a fully connected digital world will be created with 6G networks. 5G and beyond networks are of vital importance in terms of increasing efficiency in many areas. At this point, it is essential for the states to expand these networks within themselves and with each other, to take the steps that local governments and citizens should take, and to ensure the transition of existing technology by making cost and time comparisons.

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CHAPTER 8

Digital Transformation and Blockchain

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Introduction

Digitization has emerged when data has been digitized and processed by computers. Legner et al. (2017) stated that digital technologies have spread in three waves in recent years, transforming business and social life. Legner et al. (2017) exemplified the first wave as the reduction of paper as a result of the use of computers in routine work and the provision of automation. The second wave is the global spread of the internet and the emergence of new developments such as e-commerce. The third wave is expressed as the experience of businesses and society on developments in storage capacity, internet bandwidth, and processing power. With the development and spread of the Internet and information technologies, a period called Industry 4.0 has begun to be experienced. In this period, the emergence of innovative business models, new business processes, and smart products and services that emerged as a result of the development of digital technologies can be called "digital transformation".

Similar definitions of digital transformation have been made in literature and studies published by institutions: In the report published by the OECD, digital transformation is expressed as the economic and social impact of digitization (OECD, 2018). The European Commission defined digital transformation as the creation of smart products and innovative business models as a result of the integration of physical and digital systems with the development of digital technologies (Advanced Technologies | Internal Market, Industry, Entrepreneurship and SMEs, n.d.). Fitzgerald et al. (2014) define digital transformation as making the necessary structural changes and developing new business models by using technologies such as social media, mobile applications, and data mining in order to gain an advantage in the market and meet customer demands. Young and Rogers (2019) define digital transformation as a technology-driven change process derived from accessible connections, data, and decision-making processes. From the definitions made, it is understood that digital transformation covers not only the developments in digital technologies but also the impact of these developments on institutions.

The rapidly developing and widespread internet and information technologies create a volatile, complex and uncertain environment for institutions. Therefore, it is very important to understand what changes these technologies can bring to business models, business processes, and organizational structures (Matt et al., 2016). The most common digital transformation goals in the literature are; increasing flexibility, developing customer-oriented processes, and reducing costs (Hofmann & Rusch, 2017). Today, most of the shopping and financial transactions are carried out over the internet and the number of these transactions is increasing. An environment of trust is essential in such financial businesses managed on the Internet and in applications involving data storage, data sharing, and data verification. Third-party companies and/or central authorities are generally used to create this trusting environment. This situation causes important information for institutions and individuals to be made available to third parties. This poses a risk to information security and privacy. In addition, a malfunction in third-party systems will cause the entire system to become inoperable at once. Working with central authorities or using third-party applications to allocate an environment of trust between users and institutions brings both a serious financial burden and external dependency. Thanks to its distributed, transparent, immutable, and secure structure, blockchain technology, which has become widespread recently, can be recommended as a suitable option for solving these problems. With blockchain technology, the following examples can explain why it is suitable for solving the mentioned problems: In the past, several efforts have been made toward the creation of a worldwide valid digital currency. However, these studies have not been successful due to reasons such as double spending or the need for a central authority. Blockchain technology was first introduced in 2008 in an article published by a person or group named Satoshi Nakamoto (Nakamato, 2008). Blockchain technology, thanks to its distributed and transparent structure, enables data sharing between stakeholders/nodes in an encrypted and secure manner without a need for central authority. In the blockchain, data is kept in distributed ledgers. Recording data in distributed ledgers can only be realized as a result of the consensus of the stakeholders in the blockchain network. In the blockchain network, data is recorded with the consent of the stakeholders, and the record is stored by all stakeholders in a distributed and transparent manner. In this way, data security and integrity are ensured and historical data deletion or modification can be prevented. Blockchain, first known as the technology behind digital currencies, has been leading innovative solutions in many fields such as finance, supply chain, health, public services, and education in recent years. It is thought that blockchain, which is rapidly developing and becoming widespread as a new technology, will also play an important role in the digital transformation process. Since blockchain contains technologies with high potential such as smart contracts, consensus mechanisms, and encryption techniques, it is no doubt that there will be many use cases in many different fields in the future and it will play an important role in digital transformation. In the following chapters, examples and applications for the content and usage of the blockchain are mentioned.

Blockchain

Many definitions of blockchain have been made in the literature. Nakamoto, who introduced the concept of blockchain for the first time, defined it as a distributed ledger where every record is stored and shared in a distributed structure by the stakeholders in the network. Li et al. (2021), blockchain is an emerging technology that encompasses many computer sciences such as cryptography-based digital signatures and distributed consensus mechanisms.

Reyna et al. (2018) defined the blockchain as a secure data warehouse where data is stored in a distributed, transparent and immutable structure as a result of an agreement reached by the stakeholders. According to Glaser (2017), a blockchain is a database where participants keep records of their assets publicly and under pseudonyms without the need for an intermediary or central authority. Johar et al. (2021) defined blockchain as a distributed ledger technology secured by cryptography in response to the trust problem that users have experienced for a long time. Lewis (2018) has shown that, unlike traditional databases, transactions such as adding and verifying records in blockchain are done by stakeholders with consensus mechanisms on the P2P network. The features that distinguish blockchain technology from other data storage technologies can be listed as follows (Gatteschi et al., 2018; Yavuz, 2019):

0. A copy of the record is saved by all participants in the network. By keeping the record transparent in this way, data loss and data destruction are prevented.

i. It enables the development of distributed and automated applications in different fields, thanks to new technologies such as smart contracts and digital signatures

ii. Thanks to digital signature and consensus mechanisms, stakeholders are ensured to trust each other without the need for a central authority.

iii. Since it works in a distributed structure without a central authority, it cannot be controlled or shutdown.

One of the most important services offered by blockchain technology is smart contracts. It is thought that smart contracts can replace classical contracts by operating within the decentralized and predetermined rules on the blockchain network (Reyna et al., 2018). Thanks to smart contracts, banks, notaries, and similar third parties are eliminated; therefore, significant advantages are provided in terms of cost, speed, and security. It is thought that smart contracts, which are being used in many areas today, have great potential and will become more popular and widespread in the future (Luu et al., 2016). The development of the blockchain from its emergence to the present is evaluated in three phases (Burgess, 2015; Swan, 2015; Zhao et al., 2016): The first of these is the Blockchain 1.0 phase, where the blockchain is recognized as the technology that forms the infrastructure of Bitcoin and other digital currencies. The period when smart contracts and financial applications are used is called Blockchain 2.0. In recent years, widely use of blockchain in varied areas such as health, agriculture, education, public administration, and IoT is called blockchain 3.0. In the period called Blockchain 1.0, the blockchain used in the infrastructure of digital currencies was transparent and open to everyone's participation without any restrictions. In this type of blockchain in which institutions and individuals can participate in data adding or mining activities without any control, the mechanism is called a "Public Blockchain" (Puthal et al., 2018). In the blockchain 2.0 and blockchain 3.0 phases, blockchain technology began to become widespread and better understood. In these periods, blockchain has been used in different fields by institutions, companies and researchers apart from digital currencies. Most of the blockchain systems used in these studies have been implemented in such a way that authorized participants can exchange data within their authority, rather than making it accessible to everyone. Blockchain systems managed by an individual or a group that allow data sharing between individuals in one or several organizations are called as "Private Blockchain". Blockchain structures in which the authority of a single person or group in private blockchain systems is transferred to predetermined participants in the network are called "Consortium Blockchain".

In such blockchain networks, the consortium decides whether the network is public or limited, and who will join the network, and what privileges the participants will have, such as reading and writing (Puthal et al., 2018). When the phases of blockchain are examined, it can result that like the rapid technological developments in other fields, the blockchain has been developed rapidly to respond to the newly emerging needs that have arisen in its short history; and new technologies that will adapt to these developments have been put to work. However, it should not be overlooked that it also contributes to the emergence of new business areas (blockchain / Web 3.0 developer, etc.).

In addition to these, although blockchain has great potential as a new technology, some difficulties may be experienced in cases of widespread use. Some of these are as follows: Blockchain systems that use "proof of work" as a consensus protocol consume a lot of energy and require a high amount of information resource investment. For example, as of 2021, the amount of energy consumed for the Bitcoin blockchain, which relies on the "proof of work" protocol, is more than the energy consumption of many countries (Bitcoin Consumes "more Electricity than Argentina"- BBC News, n.d.). At the same time, as a result of the excessive demand for many computer parts such as the video card used in Bitcoin mining, the prices of these parts have increased greatly. Moreover, storing and verifying all the data in the blockchain by all participants can lead to situations where performance is insufficient under heavy processing load, prolonging the processing times and thus loss of time. Transactions made by users in blockchain systems are shared transparently in an encrypted manner. As a result of the analysis of this publicly shared data, it is possible to access the real identities of the accounts or the real identities of the users (Meiklejohn et al., 2013). Moreover, in addition to the difficulties encountered in applications that have been implemented and become widespread, new features may be needed in parallel with newly developing technologies. Blockchain continues to develop as new technology and many studies are being carried out by researchers and companies to overcome the aforementioned difficulties. The following sections include applications of blockchain in prominent sectors. It is thought that these applications will contribute to the formation of different new application ideas and their transformation into practice over time.

Blockchain Based Digital Transformation Applications

The blockchain, which first entered our lives with digital currencies, has pioneered many solutions that make life easier in the financial sector. In recent years, the number of blockchain-based innovative applications has been increasing. The smart contracts in the blockchain guarantee that the parties comply with the agreements and rules. Consensus mechanisms ensure that every record added to the blockchain is approved by the stakeholders. With these services offered, the blockchain not only allows the business to be carried out securely but also allows the stakeholders to trust each other (Javaid et al., 2021). Thanks to the processing of data obtained from sensors and machines, important information may emerge, and significant gains can be achieved. With the use of IoT devices, which have developed and become widespread in recent years, together with the blockchain, transparent traceability can be ensured by creating an environment of trust between the stakeholders, and thus fraud can be prevented. These developments, which offer significant advantages for production, supply, retailing sectors, and consumers, pave the way for a new digital transformation. Blockchain-based solution proposals in different fields and applications that have been implemented are given below.

Applications for Supply Chain

Today, storing data about processes such as production, food processing, and distribution in traditional supply chains, as paper-based records or in special databases causes serious difficulties. Some of them are as follows (Lin et al., 2020):

- Data stored in private and central databases can be manipulated, causing trust issues among stakeholders.
- The entire supply chain can become inoperable after a single point of failure.
- Central databases vulnerable to hacker attacks can be destroyed or confidential data may be stolen.
- High costs may arise if third-party support is sought for data validation and monitoring.

In the past years, studies involving distributed databases and cryptography have been carried out to overcome these problems. Among these, blockchain stands out with the services it offers in response to trust issues (Lin et al., 2020).

In recent years, many studies containing blockchain-based supply chain application proposals have been published by researchers. Shadid et al. (2020) proposed an application for the transparent, distributed, and secure management of all transactions from the production stage to the customer with smart contracts on the blockchain. In this study, as in many other similar studies, it has been proposed to keep data such as sensor information and production pictures encrypted on cloud servers and to store the key information necessary for accessing this data on the blockchain in order to alleviate the data load on the blockchain. In the proposed system, manufacturers, carriers, and retailers participate in the blockchain network as participants. In this study, the exchanges and payments between the participants are made through smart contracts. In addition, participants can give evaluation points and write comments about each other. This evaluation information held on the blockchain is presented as a benchmark for future purchases. In this study, the proposed application was simulated, and the results were also included.

In addition to the theoretical studies in the literature, the number of real-life applications is increasing. IBM offers its clients blockchain services for use in many areas such as supply chain, smart agriculture, vaccine applications, and authentication (Blockchain for Supply Chain - IBM Blockchain | IBM, n.d.). After the emergence of the food scandal in the past years, Walmart, one of the largest supermarket chains in the world, managed the pork trade in China and the mango trade in America in 2016, from production to the customer, using the Hyperledger-based blockchain system offered by IBM (Kamath, 2018). An application called Provenance has been developed in Indonesia in collaboration with NGO Humanity United and International Pole and Line Foundation (From Shore to Plate: Tracking Tuna on the Blockchain | Provenance, n.d.). With this application, customers can inquire where the fish was caught, and which stages it was placed on the shelf, through the QR code and RFID information placed on the tuna. In France, a tracking system called Ambrosus has been developed to track olives from fields to warehouses, and from there to the packaging factory and retailer (Ambrosus.Io, n.d.). Unlike existing tracking systems, Ambrosus provides tracking of olives with RFID technology starting from production. The exchange of olives is also done by smart contracts on the Ethereum network. Te-Food application has been developed to follow the process of pork from production to the customer (TE-FOOD, n.d.). With this application, the farmer registers the pigs to the blockchain via her smartphone with RFID and QR codes.

Then, it is ensured that the trucks used for transportation can also be tracked with RFID. The slaughter of pigs in trucks arriving at the slaughterhouse is monitored by veterinarians and identified with a QR code. In this solution, blockchain services are also used for exchanges between companies and evaluation comments for the products made by the user. The app was launched in South Vietnam in early 2017 and more than 6,000 companies have been trained to use the app. It has been stated that 25 thousand chickens and 2 million eggs are monitored daily in Te-Food, which has been used for chicken and egg tracking since September 2017.

Applications for Healthcare

Today, the use and sharing of electronic health records (EHR) of patients have become an important issue. It is thought that sharing EHRs will make an important contribution to increasing the accuracy of diagnosis of diseases and improving the quality of health services. Today, most the EHRs are stored in traditional databases which puts data security and patient privacy at risk. The World Health Organization defines EHRs as a valuable and protected asset of the patient (Michelsen et al., 2015). For this reason, consent from the patients as the owner of the data is required for the sharing and use of EHRs. Today, in parallel with the rapid development of information technologies, attack methods that threaten data integrity and privacy are also being renewed. It would be right to follow new technologies and develop appropriate solutions as a precaution against these threats. Blockchain technology with its features and opportunities, allows EHRs to be shared in an encrypted, distributed and transparent manner.

Many blockchain-based studies have been conducted in the field of health regarding secure data sharing and the protection of patient privacy. BPDS application suggested by Liu et al. (2018) is one of them. In this study, EMRs, which require large disk capacity, are stored in an encrypted cloud environment, and the key information required for viewing these data is kept distributed on the private blockchain. In BPDS, public and private key information and blockchain accounts of all user groups such as hospitals, doctors, patients, and pharmaceutical companies are created. In this study, healthcare organizations, patients, and healthcare professionals can request patients' EMRs for better treatment or medical research. Patients also approve the use of requested EMRs through smart contracts. In this way, information such as the request for each data, approval for sharing, and usage history can be stored on the blockchain.

Nguyen, et al. (2019) presented a blockchain-based solution for mobile cloud-based e-health systems, which are frequently used. In this study, an android application has been developed in which EMRs recorded in distributed Amazon cloud services are managed with smart contracts on the Ethereum network. With this service, patients are authenticated through mobile applications and smart contracts. It is ensured that doctors can access EHRs, whose key information is stored in the blockchain and transferred to the cloud environment, with authentication. Thus, the data such as who accessed which EHRs and when are kept in the blockchain. When the experimental results of the developed application are analyzed, it is stated that data management and sharing in the mobile cloud environment is provided with high performance and security.

In addition to the blockchain-based health application proposals detailed above, the number of implemented, real-life applications is increasing. A few of them are as follows; The application named MedRec, managed by MIT, provides the storage of EHRs and secure access to these data by the requesting healthcare institutions (Azaria et al., 2016).

With MedRec, patients can allow their EHRs to be used anonymously in medical research. MedicalChain is a blockchain-based platform (Medicalchain, 2022) that protects patients' identities and EHRs with advanced technology. MedicalChain also has a payment system that allows patients to pay for virtual doctor appointments using a digital currency called MedTokens. The SimplyVital Health platform is built on blockchain technology that empowers healthcare providers and patients to access, share, and even migrate EHRs (SimplyVital Health | Health/Medical | F6S Profile, n.d.).

Applications for Finance

The awareness of blockchain started with digital currencies for the first time, and today, many digital currencies are widely used in the financial sector as both payment tools and investment tools. Apart from digital currency applications, there are many blockchain solutions in finance. One of these is the B3i application, which allows the five largest insurance companies in Europe to store and share customer information on the blockchain (B3i - The Blockchain Insurance Industry Initiative, n.d.). BitGive (About Us | BitGive Foundation, n.d.) Thanks to blockchain-based donation and fundraising applications such as CAF (Charities Aid Foundation (CAF) | We Make Giving Count, n.d.), payments and expenditures can be monitored transparently. Thanks to its transparent and immutable structure, blockchain plays an important role in the digital transformation of institutions such as donations and aid organizations and foundations.

Applications for Public Services

One of the areas where blockchain-based solutions are most applied is the field of public services. In the OECD report published in 2018, it is stated that as of March 2018, 202 blockchain-based public service initiatives were launched in 45 countries (Blockchain and Its Use in the Public Sector, 2018). In Estonia, which is one of the leading countries in applying current technologies, a system that allows data such as identity information, health records, and tax payments of citizens to be stored and shared digitally on the blockchain has been implemented (E-Estonia — We Have Built a Digital Society and so Can You, n.d.). Necessary legal arrangements have been made for this digital transformation in Estonia. Due to slow and inefficient interbank money transfers, the development of an application called Project Ubin, which will enable money transfers between the Central Bank and banks to be made over the blockchain, has been started by the Singapore Money Management Authority (Project Ubin, n.d.). In 2018, a blockchain-based application called Voatz was used in the US state of Virginia so that citizens outside the country could vote in the senate elections in the countries where they reside (West Virginians Abroad in 29 Countries Have Voted by Mobile Device, in the Biggest Blockchain-Based Voting Test Ever- The Washington Post, n.d.). The Digital Turkish Lira R&D Project was initiated in Turkiye with a cooperation platform established between the Central Bank, Aselsan, Havelsan, and Tübitak-Bilgem (TCMB-Central Bank Press Release on the Digital Turkish Lira R&D Project (2021-40), 2021). In this project, studies are carried out on the use of distributed structures in payment systems, instant payment systems, and integration processes with existing systems in the blockchain network.

Applications for Education

In the field of education, where data security, data validation, and transparency are very important, blockchain-based suggestions and implementations are seen. In the report "Blockchain in Education" published by the European Commission in 2017, use case scenarios of blockchain technology in areas such as certification, lifelong learning, tuition fees, and scholarship payments to students were suggested (Camilleri, 2017).

According to an application scenario included in the report, in case of a malfunction or closure in the information system of an educational institution, it will be possible to access all certificates and student outputs produced by that institution through the blockchain system. In the report, it was also stated that thanks to smart contracts, payments such as scholarships and coupons can be made to students without the need for any intermediary, and payments for education can be received with electronic currencies.

One of the most well-known blockchain studies in the field of education is made by Turkanovic, et al. (2018). In this study, researchers developed an application called EduCTX, which allows institutions to store the credit information of higher education students in the blockchain in accordance with ECTS (European Credit Transfer and Accumulation System) (Turkanovic et al., 2018).

Thanks to this application, students can see the course credits, which they have completed in different institutions, simultaneously in their accounts on the blockchain. In addition, participating higher education institutions can perform transactions such as application and document verification via the blockchain.

In another study, Cheng et al. (2018) developed an application to keep diplomas and certificates on the blockchain instead of producing them on paper. It has been stated that thanks to the application presented, problems arising from situations such as the loss and destruction of the document printed on paper will be prevented. Thanks to the digital verification mechanism offered by the blockchain, companies or educational institutions were given the opportunity to verify the documents of the students who applied for a job.

Blockchain leads the digital transformation of these sectors by offering features and services that can overcome the problems encountered in many areas other than the areas mentioned above. As sectoral examples, the prevention of fake news in the media, production, distribution, and payment transactions in the energy field, logging in the IT field, spam prevention, data verification, and royalty management in the publishing field can be given.

Conclusion

Blockchain, which first entered our lives with digital currencies, quickly became popular and could be applied in many areas. Thanks to its distributed architecture, blockchain enables stakeholders to rely on mathematics, encryption, internet, and computing power instead of central authorities or third-party companies. Blockchain is like the technologies that have entered our lives unawareness and become inevitable, such as the internet, mobile technologies, cloud services, and the HTTPS protocol in terms of its emergence and prevalence. It is estimated that a similar digital transformation led by these technologies will be experienced thanks to the blockchain. Today, a large amount of data is generated as a result of the widespread use of IoT devices and information technologies. The information to be obtained from these data is of great importance for increasing the quality of service, advertising, and R&D activities. Therefore, in this period, which is also called Industry 4.0, issues such as data sharing, data security, transparency, and avoidance of centralized structures attract institutions and individuals. At this point, blockchain has attracted the attention of companies and researchers thanks to its features such as smart contracts, digital signature and distributed architecture, and it leads the development of solutions that make life easier in many areas. In this study, firstly, information is given about the concept of digital transformation and blockchain.

In the following sections, the definition, features, development process, types, and services of the blockchain are explained.

Finally, the contribution of blockchain to digital transformation was mentioned and information was given about theoretical and implemented blockchain-based applications in many fields such as supply chain, finance, education, and health. These applications, which are increasing in number and spreading rapidly, have brought about an evolvement and change in different sectors.

As a transformative technology, blockchain has entered our lives in many areas and is still developing and becoming widespread. In this context, individuals, institutions, and organizations need to keep up with this change and renew themselves digitally. For this, it will be an important step for countries to include blockchain technology in their education curricula at different levels. Since blockchain has the potential to be used in many areas, it is critical for future generations to use this technology effectively and correctly, especially in vocational education areas such as health, informatics, communication, agriculture, industry, and the addition of elective and applied course contents in undergraduate education.The share of the information and communication sector in the world economy is gradually increasing. Blockchain technology has also taken its place as an important employment area in this regard, and new professions such as blockchain specialist, blockchain network specialist, and smart contract developer have emerged. In Turkiye, "Blockchain Programmer National Occupational Standards" were published in the Official Gazette on Monday, May 23, 2022 (Blockchain Programmer, 2022).

Creating new employment opportunities by organizing academic and vocational training for this new profession will provide an important competitive advantage for institutions and countries. Blockchain-based digital money applications attract great attention from people around the world. People use digital currencies to generate income through money transfer, investment and trading. There are many frauds and grievances in the world for digital currencies, which have entered our lives and become widespread thanks to the convenience they provide. Due to the distributed nature of the blockchain and the use of anonymous identities, there are difficulties in dealing with the grievances experienced in this area, legally with the methods in practice. In order to eliminate this deficiency, necessary legal arrangements should be made by experts in the field of informatics and law as soon as possible. Blockchain continues to develop as new technology and attracts great attention from people.

Finally, emerging NFT (Qualified Intellectual Deed) applications have become widespread rapidly and have found use in many areas. As in digital currencies, fraud and victimization are experienced in NFT applications as a result of misunderstanding and misuse of technology by people. In order to prevent these grievances, it is important to inform society about blockchain-based crypto money NFT and future applications through public service announcements and similar ways.

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CHAPTER

Paradoxical Communication that Prevents Digital Transformation

9

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Paradoxical Communication that Prevents Digital Transformation

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Introduction

In order to meet the challenges of increasingly dynamic and volatile times organizations have to combine information and information technologies and transform how they do business. One such technology they can use is Digital Transformation. Digital transformation (DT) is "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019). Literature related to DT provides great promises to organizations that are able to transform successfully. Iansiti and Lakhani (2014) claim that if the organizations can establish the required infrastructure DT creates unprecedented replication opportunities at almost zero marginal cost. Greenstein, Lerner, and Stern (2013) claim that organizations can transform social interactions by gaining new methods of accessing data and information. This way organizations can transform how people interact so they can facilitate the emergence of new opportunities. As market actors adapt to changes they can keep their existing competitiveness or gain a competitive edge by adopting to changing rules (Pigni et al., 2016; Weill & Woerner, 2013).

Against all the promises of DT, many companies are struggling with the transformation (McConnell, 2015). Success rates in achieving the actual implementation are around 30 percent (Bucy et al., 2016). When we look at the literature there are several important issues associated with Digital Transformation (DT) that prevent successful transformation and a plethora of corresponding advice to make DT efforts successful. Table 1 provides a short summary of the issues found in the literature and the given advice regarding the issue.

Table 1. Issues and advice regarding digital transformation

Issue	Advice
The definition of Digital Transformation is vague and unclear.	What is important is that the key stakeholders should have a shared understanding and common goals. They should understand that digital transformation is a continuous process.
DT is a strategic undertaking.	There should be a clear strategy not only for the DT but also for the organization as a whole.
DT threatens existing businesses and business processes.	Top management should be aware of the threats that digital transformation brings about for the existing business. They should find win-win solutions for everyone.

Purely functional focus and silo thinking prevent DT.	Digital transformation requires collaboration between different functions and actors. The top management should facilitate digitalization and share their knowledge. Organizational silos should be brought down because digital works across disciplines and departments.
Digital transformation gives power to the man at the top.	The leader should have a clear focus on tangible performance while simultaneously exploring different approaches. Management must create transparency, open dialogue, and education. They should also be clear that some of the jobs in the organization are going to be replaced.

In this chapter, we would like to point out a more fundamental issue that leads to the failure of DT initiatives. If what we are suggesting is valid then solutions developed to implement the advice above would lead to more failures. In order to better understand this fundamental problem, DT efforts can be viewed as a part of a wider problem of organizational learning which is embedded in the human processes of the organizations. Organizations learn when individuals acting as agents for the organization learn (Argyris, 1997). The learning of individuals is enabled or inhibited by systemic factors called an organizational learning system (Argyris, 1977). Learning is detection and correction of error (Argyris, 2000). Error is the difference or gap between the desired outcomes and achieved outcomes. Let's say the management of an organization decides to undertake a digital transformation. If the organization can transform itself then we can say that the organization achieved its intended goal. But if the efforts fail then there is an error. Argyris claims that errors can be corrected in two ways, single-loop learning or double-loop learning. In single-loop learning, the underlying goals and assumptions are not questioned. The ways to achieve the goals are reviewed and if necessary changed. The job gets done and goals are achieved. Organizations and most management technologies are based on single-loop learning. Double-loop learning occurs when the underlying goals, assumptions, objectives, and policies are questioned and reviewed. When the organizational actors review which assumptions, hidden systemic goals, and values led to the errors and change them then the organization double-loop learns. Literature indicates that double-loop learning is a rare event (Argyris & Schön, 1996; Dixon, 2002; Martin, 2003; Robinson, 2015). The lack of double-loop learning can be traced back to assumptions and reflexes embedded in communicative processes around difficult conversations in the organizations (Edmondson & Smith, 2006). First let's look at the paradoxes and resulting double binds in communication. Then we will provide an example of how communicative and social processes around difficult issues prevent organizational learning.

Paradoxes and Double Binds in Human Interaction

Communication is the essence of management work (Winograd & Flores, 1987). Human communication is a complex process that depends on both content and context. Communication is not only the words uttered, which constitute the content of the communication but also context which is the tone of voice, the body language, meanings intended as well as how the communicating parties are related to each other in terms of their position in the social setting. If a manager says to a subordinate *"I don't have your report"* the subordinate uses the manager's tone of voice, body language, and the context of the conversation to make meaning of this statement (Ross & Nisbett, 2011). Depending on these factors the subordinate can perceive the statement as a reminder, a joke or a reprimand. Since a simple statement can mean many things, the ambiguity in the communication can be dealt with by seeking clarification such as asking the question *"what do you mean?"* Such a question is called metacommunication, a communication about communication (Hoppenbrouwers & Weigand, 2000). When metacommunication is not established, further difficulties in communication arise. This lack of metacommunication can be due to lack of time, lack of communication channels, and usually the understanding of the parties. There is a communicative pattern that deeply disrupts the effective working of human systems and organizations. This pattern is called a double bind (Watzlawick, 1977, p. 18). First described by Bateson and others, (Bateson et al., 1956), double binds are encounters where a person of power gives a message that creates a situation in which the receiving party fails to act successfully no matter what. Double binds are repeatedly occurring situations that involve a figure of authority and one who is (for the purpose of definition) as "subject." In the situation that creates the double bind the authority figure makes a statement that imposes the subject with the injunction that can be in one of the two following forms:

"do x or you will be in trouble."

"do not do x or you will be in trouble."

The trouble can include actual or perceived punishment, expression of anger or abandonment by the authority figure. Bateson argues that what is important is the relationship between the authority and the subject. The general characteristics of the relationship that produces the double binds can be given as:

1. The subject is involved in an intense relationship in which he has to discriminate accurately what sort of message is being communicated so that he may respond appropriately.
2. He is given a message that contains two different messages and one of these messages denies the other.
3. The subject is unable to comment on the message to clarify. That is, he cannot state the conflicting messages and ask for clarification.

This way the subject receives two conflicting messages or demands neither of which can be ignored or escaped. In such a situation no matter which demand he selects to fulfill the other demand will be impossible to meet. Although double binds are often utilized as forms of control without open coercion (Bateson, 1987) they are not necessarily so. Double binds can arise from the perception of coercion or control (Argyris, 2000). Communication that creates double binds is paradoxical (Watzlawick, 1977) that is they produce the opposite effect they intended. Watzlawick gives the example of a wife who needs affection from her husband. The wife tells her husband "I wish you would bring me flowers." While this request is reasonable, the wife ruins her chances of getting the affection she wants because the statement puts the wife and the husband in a bind. If the husband brings the flowers she will feel dissatisfied because he didn't do it out of affection but because she told him to do it. If he does not bring the flowers, then it signifies (to her) that he does not love her. Paradoxical communication creates double binds that lead to lose-lose dynamics. Double binds are stressful and can lead to counterproductive behavior and unintended consequences when actors are trapped in the process and punished for the ways the find out to escape the dilemma. On the other hand, attempting to find out about the nature of dilemmas and ways to resolve them can lead to personal and organizational growth (Argyris, 1982; Robinson, 2018). Now let's look at a case in which problematic communication leads to double binds which in turn causes an organization to fail in achieving its goal.

A Digital Transformation Case

The executive board of one of the biggest organizations in its sector in the country decides that a digital transformation is a necessity. Several consulting firms are identified to help the transformation effort. In a meeting, the board creates a team from managers as well as technical experts within the organization to prepare a report about the capabilities of the firms so the winning firm can be decided. Later in the meeting the CEO makes the following statement:

"I know we have identified several consulting firms. I suggest adding the X firm to the list. That is because I know the CEO of X and they have successfully helped transform several organizations. But this is my personal request and should not affect your decision. You should prepare the report objectively and based on the firms' capabilities. Do you have any questions about this matter?"

No one asked any questions and the meeting was adjourned. After the meeting, the team is virtually divided into two. The first group thought that the CEO wanted the X firm to be awarded the contract because the CEO of X was his friend. One of the writers asked this group how they knew what the CEO wanted. The answer was "you heard what he said. He definitely wants us to prepare the report that shows X as the best candidate. But we should be careful because he has to cover his back. That is why the report must look objective."

The second group thought that the CEO really meant what he said when he said "you should prepare the report objectively and based on the firms' capabilities." But they also thought that they shouldn't let the X firm look too bad because of the CEO's friend.

The managers give their subordinates their respective messages. One manager who initially believed that the CEO wants an objective report said to her subordinates: "we are going to prepare a report about vendors. I want you to make technical criteria as clear as possible since we should be as objective as possible both in our own requirements and the capabilities of the potential vendors. By the way, X firm looks like a promising candidate. We may be working with them."

One other manager who believes that the CEO already selected X says to his subordinates: "It is already decided that X will be the vendor. But we must make sure that they can meet our requirements. Thus we must prepare an objective report about our requirements and the capabilities of other companies." Notice how the manager's give their own ambiguous messages to their subordinates, act as if they are not doing so and act as if this is not the case. This way, at each level of the organization, the confusion increases while people act as if they clearly know what is going on. Initially, subordinates prepare very detailed technical reports using objective technical specifications. Some of the reports show X firm as a better candidate some not. Manager's find these reports risky because they provide a clear answer to an ambiguous demand thus may put them in an embarrassing situation. So they change the wording of reports into more vague statements that can be interpreted as both favoring X and not favoring X. The CEO finds the reports very detailed but too vague to be helpful in making a decision. None of these are discussed. The CEO thanks the team and unilaterally makes the decision to develop a solution internally. After two years and spending a few million the CEO is fired. The new CEO thinks that internal development is a pit of money, abandons it and outsources the DT transformation.

What happened?

Now let's try to make sense of what is going on in the organization.

1. The CEO provides a message that contains ambiguous meaning and acts as if the message is not ambiguous.
2. Team members select one possible meaning and act as if this is what the CEO meant. They don't want to embarrass the CEO by raising the ambiguity in the message because doing so would in turn embarrass them.
3. The directors when become aware of the other possible meaning, hedge. That is they take action in ways that will prevent his or her embarrassment thus reducing their personal risk.
4. In order not to get embarrassed in front of the others, the manager's by-pass is perhaps the most important factor in the success of the DT: what exactly the CEO wants and act as if they are not doing so.
5. A very critical component of the DT becomes undiscussable and its undiscussability undiscussable.

The CEO provided a message Argyris calls a "mixed message." A mixed message is one that contains inconsistent, conflicting demands, ambiguous meanings but is communicated as if it is consistent (Argyris, 1994). When the receiver of a message equates the constructed message as the intended message then there is no perceived need for clarification because he considers the meaning he made as the meaning the sender intended. In our example when the manager says "I don't have your report" and the subordinate interprets this utterance as a reprimand he or she will react to the perceived reprimand. The subordinate will not need to check whether the utterance was meant as a reminder, a joke or a reprimand. This simple communicative process can lead to a communicative pattern which in turn leads to very complex and counterproductive consequences for the organizations. In our example, the CEO on the one hand asked for an objective report. On the other hand, he said things in favor of X company. In order to act effectively the director's need clarification about the CEO's actual intention or interest behind the message. What prevents organizational actors from demanding such a clarification? There are several factors. One important factor is their own understanding. Even the message is ambiguous, when the receiver selects one of the possible meanings and treats that meaning as if it is very clear leaves out the need for clarification (Martin, 2007). Another important factor is the actors' understanding of their social system. We got clues about the social system within the executive board with two examples: When we asked one of the board members what prevented him from asking the CEO for clarification he said "Are you crazy. I would look like a fool." One other board member answered the same question by saying "he would deny that he wants us to select X". Yet another member answered "I know that he has our organization's best interest in mind. But perhaps the CEO of X asked for a favor and (our CEO) wants to be in a position where he can say he tried." The social system within which the executive board lives and acts, at least in their perception, leads them to believe that when they ask for clarification they "will look like a fool." Within this social system it is a legitimate move to make attributions about others' intentions, not test these attributions and act as if they are right. Also they are acting as if they are not doing so. This way the communicative process used by the management puts them in a tough spot. If they prepare a report explicitly favoring X, they will not be acting objectively and to the best interest of the organization which good management requires. If they prepare an objective report they can get into trouble with the CEO. Thus now they are in a double bind. In order to get out of the bind they have to metacommunicate -ask for clarification- but the social system they created and within which they operate is not conducive to such a move. Thus the managers act in ways that increase the ambiguity of the message sent from top down and act as if they are not doing so. Argyris calls these types of interactions “inhibiting loops” (1977) because the inhibit detection and correction of errors. Using thousands of cases from all over the world, Argyris and Schön (1978, 1996) found out that when people come across ambiguous, conflicting, inconsistent information they act in ways that increase the ambiguity, conflict and inconsistency. The subordinates find themselves in the same situation and act similarly thus the ambiguity multiplies at each management level. The reports prepared under such conditions become increasingly detailed, unclear, vague and thus unusable by the top management. When the CEO reads the reports he makes his own attributions about what the managers are trying to do. He thanks the managers for their hard work and dismisses the reports. The managers in turn believe that they were right that the CEO would do whatever he wanted and were asking for reports only to support his already decided position. This way the organization has a circular process in which ambiguity, vagueness, and inconsistency increase at every level from top down and subordinates’ reactions feed back to increase these factors. In such a circular process, talking about errors and their causes becomes increasingly threatening.

Implications for Digital Transformation

Based on our understanding of circular patterns of interaction working in the organization that both lead to errors and at the same time prevent detection and correction of errors and the social skills and environment that facilitate those patterns, we can review the advice regarding DT. It is important that stakeholders should have a shared understanding and common goal. Key stakeholders should understand that digital transformation is a continuous process. Organizational actors usually understand that as the environment changes organizations also need to change. On the other hand, the communicative and social processes within the organization remain the same across changes. In our example, although the executive board as well as managers had the same goal of transforming the organization they failed to achieve this goal and are unaware of how they contributed to this failure. Recommendations regarding DT do not deal with the human processes in the organization that works against the shared meaning, common organizational goals. The counterproductive processes cannot be identified and removed easily because many times these processes are part of the organization. People are usually unaware of the fact that they trigger and drive these processes and whenever they become aware they act in ways that further proliferate the process.

There should be a clear strategy for both DT and the organization. Having a clear strategy does not guarantee a successful implementation. Failing to detect where the implementation failed and the inability to correct the errors undermines the strategic efforts.

Top management should be aware of the threats to the business and they should find win-win solutions. People, especially top management are usually aware of threats and attempt to avoid such threats. The communicative processes used to communicate the threats internally and deal with those threats undermine win-win solutions and lead to win-lose solutions. **Digital transformation requires collaboration between different functions and actors.**

Organizational silos should be brought down because digital works across disciplines and departments. Organizational actors collaborate for enabling transformation and unknowingly inhibit the transformation. As digital works across disciplines so do the communicative processes that inhibit effective learning. **The leader should have a clear focus on tangible performance while simultaneously exploring different approaches.** This is paradoxical advice and as seen in the example above, when managers attempt to deal with paradoxical situations, instead of making what is ambiguous clear, what is inconsistent consistent, and what is vague explicit they escalate the ambiguity, inconsistency and vagueness. **Management must create transparency, open dialogue and education. They should also be clear that some of the jobs in the organization are going to be replaced.** When dealing with difficult issues, management creates opacity, prevents dialogue around difficult issues, and educates subordinates in ways that further make open dialogue difficult. The recommendations regarding DT and its implementation does not deal with the inherent communicative and human processes that exist in the organization and works in ways that undermine organizational effectiveness. These processes are rarely surfaced and dealt with. The literature about organizations provides very little examples about how to effectively deal with such processes. More research is required to better understand the dynamics of these processes not only in organizations that achieved effective transformation but also in those that failed to do so.

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CHAPTER

10

Effect of Virtual and Augmented Reality Applications on the Education of Persons with Disabilities

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Effect of Virtual and Augmented Reality Applications on the Education of Persons with Disabilities

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Introduction

It uses the information it has received from 5 sense organs in order to make sense of the phenomena and activities taking place around individuals. About 80% of this information is provided to individuals through the eye organ. For individuals who have lost their sense organ, which has such an important effect, this situation causes many difficulties. Visually impaired individuals can access information by having others read to them or by reading sources written in Braille when the conditions (technology) are limited. Along with this situation, some internet applications are also provided to visually impaired individuals. Some web pages transmit information audibly, allowing our disabled individuals to use the web page and access information more easily. At this stage, all web applications should have additional features for visually impaired individuals; It is of great importance that the visuals, videos and sound recordings are in an explanatory state. In addition, virtual reality environments can be developed for our disabled individuals who are in the background in the normal education process and have a more difficult learning process compared to normal individuals, and for our visually impaired individuals, images can be perceived, even with low resolution, with the systems produced (Ferhat, 2016).

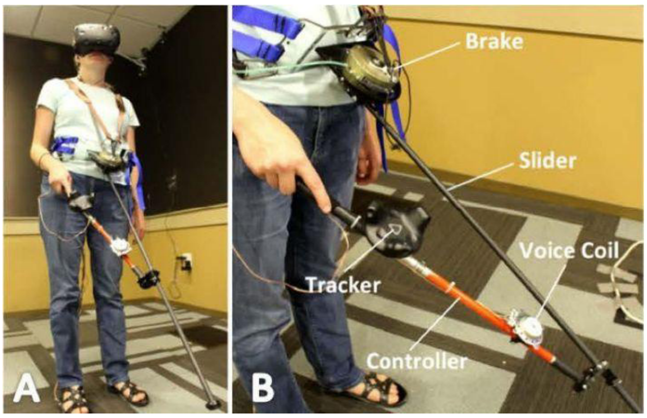

Figure 1. Augmented reality technology developed for visually impaired individuals.

Disabled in the World

According to OECD-EU data, approximately 15% of the world's population consists of individuals with disabilities. By looking at this rate, we can say that there are close to 1 billion disabled people in the world. If we take a look at the age distributions, 27% of these individuals are between the ages of 0-21, 36% are between the ages of 22-49, and 37% are between the ages of 50-64 (Disabled People in Turkey and the World, 2021). According to the data of the "Lancet Global Health" magazine (The Lancet Global Health, 2020)., the number of visually impaired people in the world is approximately 36 million, and this rate is considerably higher than the number of individuals with other types of disabilities. In addition, the regions with the highest rate of visually impaired individuals are South Asia and Sub-Saharan Africa. Studies have shown that more than 200 million people from 188 countries have a moderate and severe visual impairment, and this figure will exceed 550 million in 2050 (The Number of Visually Impaired in the World May Reach 115 Million, 2017).

Enhanced Virtual and Augmented Reality Applications for the Disabled

Augmented Reality technology is two different concepts from Virtual Reality technology. Virtual Reality; While a virtual environment is created by means of computer technology and the user's access is aimed on this environment, Augmented Reality is a technology developed by overlaying the designed graphic data on real-life objects. This difference in the use of Augmented Reality and Virtual Reality provides diversity in the development of applications that appeal to the use of individuals. If we consider the systems made on Virtual and Augmented Reality for the Disabled; With Location Based Augmented Reality applications, the location of the visually impaired individual can be detected by GPS, WLAN, etc. It adds virtual data (sound data) to the real image by detecting it with devices, and thus the guidance of the visually impaired individual is carried out very easily (Sirakaya & Seferoglu, 2016). If we examine the ITOAG-based systems developed for disabled individuals, the system takes place in the environment instead of signal data. The application of this technology, which is realized by the movement of a field object or superimposing Augmented Reality data on a certain field surface, can be given as an example by Mirzaei, Ghoshi, and Mortazavi (2012). That can convert the sound data obtained in the speech of hearing-impaired individuals into writing. The most important advantage of the Signless Tracking System Augmented Reality Technology (ITOAG) is that the area where the object is displayed is not fixed. Due to this situation, it is possible to direct the disabled person depending on the object area or region that is perceived as motion sensitive(Mirzaei et al.,2012).

Figure 2. ITOAG technology developed for hearing impaired individuals (Tsai et al., 2013).

A study was carried out by the VI. Yıldız International Social Sciences Congress (Dolunay & Akkan, 2019) in order to enable visually impaired individuals to access written information, bibliography and documents more easily during their university education. As a result of the interviews and evaluations made with visually impaired individuals before this study; 60% of the information documents they had difficulty with were electronic, 52% were Braille, 48% were cassette/CD and 8% were large print source documents. In the continuation of this study, 60% of the information document types that visually impaired students have difficulty in making use of were journals, 52% were books, 44% were theses, 36% were conference proceedings, 32% were counseling resources, and 4% were websites. . As a result of these preliminary studies, on the web pages;

- Font size: Written data is visible to individuals with low vision.
- Use of contrasting colors: Contrasting colors and tones are included for color-blind individuals.
- The text of the visuals: The pictures must be readable in written form and appealing to the visually impaired user audibly.
- Availability of information resources: As a result of preliminary work, disabled people can access their frequently used Internet data documents as a result of no more than three clicks. Thus, it has been ensured that our disabled individuals can benefit from internet documents during their education.

Virtual and Augmented Reality in Special Education Process

Virtual and Augmented reality applications are technologies that have an important place in the interactive learning and knowledge discovery of individuals with disabilities. For this reason, studies have been carried out to increase the learning opportunities of individuals with disabilities by making use of Augmented Reality technology in the special education process of individuals with disabilities. We can show the anatomy learning mobile Augmented Reality application for the education of disabled people in Türkiye as an example to this study. In this study, cards with pictures and information about the skeletal structure were prepared and signs were placed on the cards in order to perform sign-based tracking on these cards. 3D skeleton models were designed to be used in the Augmented Reality mobile application. (Uzun et al., 2017).

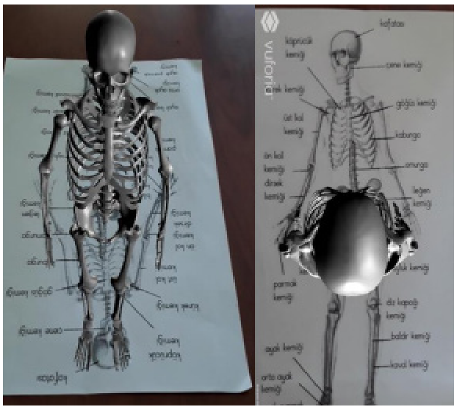

Figure 3. Augmented Reality model of human skeletal structure.

With this study, an interactive learning style was introduced by providing convenience in the education process of disabled students. Another study for this area is the adaptation of Augmented Reality technology supported storybooks for disabled children. With the audio support in this study, our visually impaired individuals will be able to benefit from the storybook comfortably, and for our individuals with other types of disabilities, the storybooks will be supported with 3D models and brought to an understandable level (Dogan, 2016).

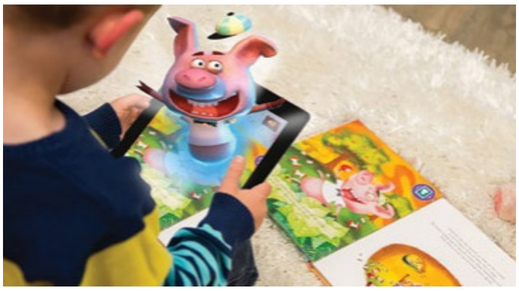

Figure 4. Augmented Reality supported storybook.

The Effect of Virtual and Augmented Reality Technology on the Mental Development of Individuals with Disabilities

In order to see the effect of Virtual and Augmented Reality technology on individuals with mental development disorders, research was conducted on the basketball game application developed with the support of Augmented Reality technology. Disabled individuals were asked to play the game without any prior information. Movement, sliding, throwing, etc. of disabled individuals during the game metaphors such as these have been examined and it has been emphasized that these individuals can be recommended both in terms of providing physical practice and improving their conscious mind levels (Altan et al., 2019).

Figure 5. A few sample images taken during the application.

In this study, it was determined that the Augmented Reality game, which was evaluated with certain metaphors, contributed to the mental development of individuals with disabilities.

If we examine another study carried out to determine the mental development of disabled individuals; In this study, which was conducted on a total of 93 students, 11 of whom were cognitively disabled, in a French primary school, the performance and behaviors of students in using Augmented Reality technology, as well as the attitudes of cognitively disabled individuals in such techniques were examined.

As a result of this study, it has been determined that disabled individuals are very enthusiastic when using the application and exhibit higher motivation compared to other students (Richard et al., 2007) Virtual Reality applications also make positive progress in the recreational development of our disabled individuals. If we examine the studies on this situation; It seems impossible for an individual with walking disability to do mountain climbing sports, but with virtual reality applications, they can experience such activities in a safe and unlimited way. However, before traveling on unfamiliar roads, individuals with physical disabilities can provide effective planning on the road with Virtual Reality application (Kulakoglu Dilek & Istanbullu Dincer, 2020)

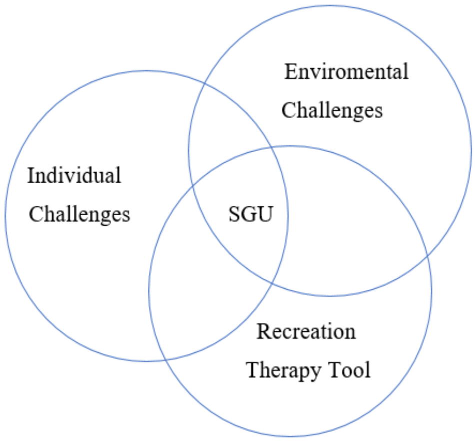

Figure 6. Supporting role of Virtual Reality applications (SGU) in the participation of people with disabilities in recreational education activities.

By looking at these studies, it was predicted that individuals with mobility impairments achieved positive results in recreational treatments with Virtual Reality applications, and that they could perceptually realize the experiences they were intended to gain.

Conclusions

While the rate of disabled individuals around the world is at high levels, certain studies and studies have been observed in order for these individuals to maintain their lives, especially their education. It has been observed that especially the number of visually impaired individuals constitutes a large community around the world, and that they suffer from great disadvantages such as not being able to access written documents and internet resources, and not being able to access visually supported information, and these disadvantages are tried to be minimized with Virtual and Augmented Reality technology applications. In addition, during the education of our individuals with different types of disabilities, AR and SG supported educational books were designed and these books were supported with sound, image, video and 3D graphics, contributing to their development. It is expected that these evaluated studies will be used in a wider range and will be improved to optimum levels. In addition, it has been determined that Virtual and Augmented Reality technology has positive effects on the mental development of young individuals and increases the level of motivation. It is predicted that such studies can be supported more and further differences can be achieved in the mental development of individuals with disabilities. AR resources, which include learning behaviors that students with disabilities are expected to achieve, are among the resources that will be included as an alternative during education. By increasing the AR model image quality of such sources to higher levels, it is foreseen that an environment will be created in which especially hearing impaired students will actively participate in the education environment. Apart from these, the existence of disabled individuals is also undeniable in the new generation, which is called the Z generation, and the technology, methods and materials used today in the education process of these individuals are insufficient (Richard et al., 2007). It is expected that by eliminating this inadequacy, individuals with disabilities will be able to acquire the learning behaviors expected to be acquired.

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CHAPTER

Digital Transformation and Productivity in Higher Education

11

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Digital Transformation and Productivity in Higher Education

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Introduction

In today's globally competitive environment, industries must put change and transformation on their agenda to keep up with innovation and continue their activities. Especially in the 21st century, known as the digital age, businesses need to perform their transformation activities quickly. This transformation, which has been going on for years, started as the first industrial revolution in the 1700s and continues today as the fourth industrial revolution. Industry 4.0, first heard at the Hannover Fair in Germany in 2011, has led to a digitalization process that the world has followed closely (Gabacli & Uzunoz, 2017; Kagermann et al., 2013). This digitalization concept, which emerged in the 3rd industrial revolution, has left its place in digital transformation with Industry 4.0 (Sukhova, 2016).

Before moving on to what digital transformation is, it would be appropriate to explain the concepts of digital and transformation. Digital is expressed as the state of being numerical and consisting of 0-1. That is, analog signals are replaced by digital signals (Tilson et al., 2010). This expression evokes technology. Transformation means change and innovation, and in the process, it means digital structuring in general. However, digital transformation expresses an approach beyond the combination of these two concepts and is beyond technology (Henriette et al., 2015). Because it can be said that digital transformation is not only based on the use of technology, but also on a vision and strategy. This concept, which is not an instant process, requires long-term planning (Seres et al., 2018). In this context, there are different definitions of digital transformation in the literature. Some of them are as follows.

> *It is the holistic transformation carried out by organizations in human, business processes, and technology elements to provide more effective-efficient service and to ensure beneficiary satisfaction (TUBITAK-BILGEM, 2020).*
>
> *Digitization means using digital technologies and data to generate revenue, improve businesses, change/transform business processes and create digital business environments (Schallmo & Williams, 2018).*
>
> *With the use of technology, unlike the use of existing services in the digital environment; refers to a holistic transformation process formed by the individual, business processes, and technological elements (Karaman & Aydin, 2020).*
>
> *It covers both the digitization of the process with a focus on efficiency and digital innovations that focus on improving existing physical products with digital capabilities (Berghaus & Back, 2016).*

This concept, which has a very heavy financial burden, is accepted as one of the biggest trends in the industry and public sector and affects many areas. Sectors such as health, transportation, industry, agriculture, finance, retail, and education are some of them (Sandkuhl & Lehhman, 2017). In this process, where the transition from industrialization to complete digitalization takes place, the perspectives of educational institutions and their adaptation to this transformation are very important. With digital transformation in educational institutions, it is expected to provide opportunities to students by using both traditional classroom-based methods and modern technologies and increase efficiency by facilitating learning, especially in higher education (Jain, 2019).

Digital Transformation in Higher Education

When students graduate, the knowledge gained in the first years of the university is now outdated (WEF, 2016). In this rapid change, the structure of universities should be re-examined, and they should be transformed into structures that keep up with the age and even manage the age (Aybek, 2017). These institutions, which are one of the important elements of social change and transformation, are very important in terms of using and developing technology, adapting people to these technologies, and creating an information society. It is a known fact that the use of new technologies in the digitalization of higher education is not yet at the desired level. This situation pushes universities into a transformation (Akteke et al., 2008). In addition, higher education institutions must put digital transformation on their agenda to survive and continue their development, as in other sectors (Colone, 2019).

Increasing competitiveness and changing student expectations and changing teacher roles seem to be among the underlying causes of digital transformation in higher education (Scott, 2022). In addition, universities are trying to use and even add new information technologies that will save their teaching activities from time and space limitations. In this context, higher education institutions had to keep up with digital transformation and make changes in management, infrastructure, business processes, and professional development (Margaryan, 2011; Taslibeyaz & Tasci, 2021). This situation has increased the activities for the use of digital resources in the learning process (Seufret & Meier, 2016).

The digital transformation observed in higher education, which first started with the establishment of corporate web pages and then with basic processes such as student affairs, student information systems and library services, and educational processes began to digitize, especially with computer-aided applications. In addition, the intense use of distance education applications, and then the integration of digital technologies and e-learning into face-to-face education processes accelerated digital transformation activities in higher education (Bates, 2015; Navitas Ventures, 2017). With these digital transformation activities, opportunities such as following the lessons easily, providing online collaborative learning opportunities, providing improved communication between student-instructor-staff, realizing a positive learning process with multimedia-supported learning opportunities, and getting instant feedback on online platforms (Bilyalova et al., 2019; Kaur, 2019; Lynch, 2020; Nsocialtr, 2020; Pham, 2021).

These activities provide institutions with advantages such as flexibility and adaptability (James, 2021), improving the student experience, optimizing resources (Spear, 2019), and increasing efficiency (McKinsey & Company, 2012) within the scope of digital transformation. The reflections of productivity, which is one of the advantages it provides, in higher education institutions; human resource efficiency as a result of doing more work with less staff (Betchoo, 2016), the efficiency of education-teaching processes with higher education staff with digital skills (Faria & Nóvoa, 2017), and sustainability efficiency with smart campus applications (Musa et al., 2021) can be listed as. In this study, which emphasizes the importance of efficiency, which is one of the reflections of digital transformation in higher education, it is aimed to examine the trend in the literature toward the concept of digital transformation and efficiency in higher education. In this context, answers to the following research questions were sought.

R.Q.1. What is the distribution of studies on digital transformation and efficiency in higher education by years?

R.Q.2. What is the distribution of studies on digital transformation and efficiency in higher education by language?

R.Q.3. What is the distribution of studies on digital transformation and efficiency in higher education by publication type?

R.Q.4. What is the distribution of studies on digital transformation and efficiency in higher education by country?

R.Q.5. What is the distribution of the most used keywords in studies on digital transformation and efficiency in higher education?

R.Q.6. What is the Three-Field Plots Analysis of studies on digital transformation and efficiency in higher education?

R.Q.7. What is the Thematic Map Analysis of studies on digital transformation and efficiency in higher education?

R.Q.8. What is the Factorial Analysis of studies on digital transformation and productivity in higher education?

Methodology

Research Design

Within the scope of the study, document analysis, one of the qualitative research methods, was used. Document review, it refers to the analysis of written materials containing information about the researched subject (Yildirim & Simsek, 2008). To reach related studies in the literature, Web of Science (Wos) and Scopus databases were searched with related keywords, and bibliometric and text-mining analyses were used to examine the studies reached. Bibliometric analysis is based on the extraction of a general framework and analysis according to certain characteristics (Marti-Parreno et al., 2016; Yavuz et al., 2021). Text mining, on the other hand, is used to obtain meaningful information by extracting the main trends from the text in big data (Aydemir et al., 2021; Feldman & Sanger, 2007). VOSviewer and RStudio programs were used to perform the analyses.

Sampling

Derivatives of the words "digital transformation, higher education, university, efficiency, and productivity" have been brought together to reach studies on digital transformation and productivity in higher education. The number of studies and selection processes obtained in the scanning conducted in both databases are given in Figure 1.

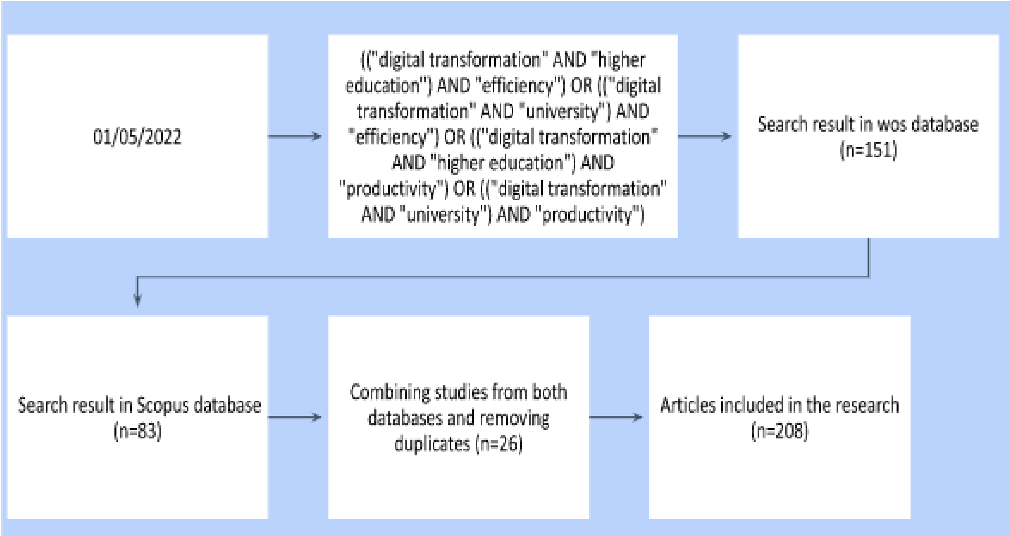

Figure 1. Selection: PRISMA Flow Diagram (Liberati et al., 2009)

Search results with keywords in Wos and Scopus databases were exported and imported into the RStudio program to be combined. As a result of the combination, it was determined that 26 studies were repeated, and these repetitive studies were removed. Later, with 208 studies obtained, analyzes were carried out in both VOSviewer and RStudio programs.

Data Analysis and Research Procedures

The VOSviewer program is a functional and useful tool for visualizing data and bibliometric analyzes are performed (Goksu et al., 2020). Bibliometric and text-mining analyzes are also performed with the RStudio program. Various analyzes were performed using both programs. These analyzes are the distribution of studies by years, distribution of studies by languages, distribution of studies by publication type, distribution of studies by country, the most used keywords, three-field plots, conceptual structure map, and thematic map.

Findings

In this section, the trends of the studies in the literature within the scope of the concept of digital transformation and efficiency in higher education are presented and the general scope of the studies is presented. The findings obtained in this context are given below in parallel with the research questions. First, general information about the studies examined as a result of the analysis carried out is given in Table 1.

Table 1. General information on the studies reviewed

Description	Results
Timespan	2012:2022
Sources (Journals, Books, etc)	153
Documents	208
Average years from publication	1.91
Average citations per documents	3.851
References	8346
Keywords Plus (ID)	532
Author's Keywords (DE)	765
Authors	705

Authors of single-authored documents	22
Authors of multi-authored documents	683
Single-authored documents	27
Documents per Author	0.295
Authors per Document	3.39
Co-Authors per Documents	3.54
Collaboration Index	3.77

R.Q.1. Distribution of studies by years

Within the scope of the first research question, the distribution of the studies in the literature by years was examined. The results obtained in this context are given in Figure 2.

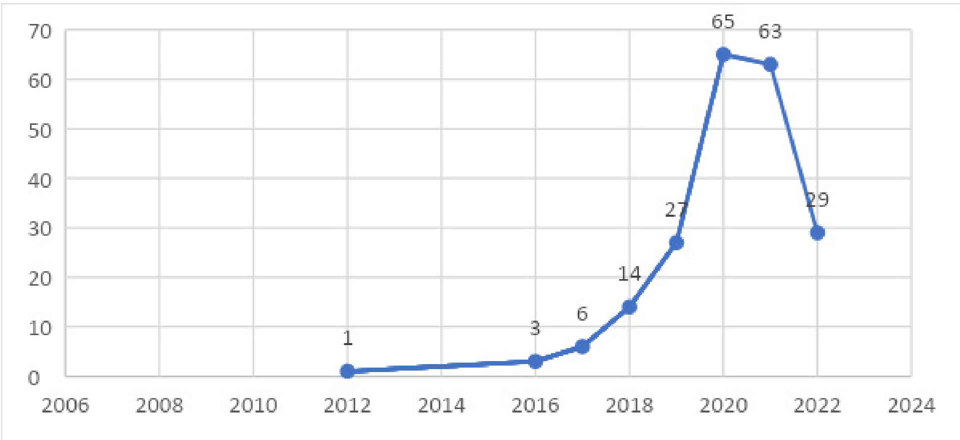

Figure 2. Distribution of studies by years

When Figure 2 is examined, it is seen that the studies were carried out between the years 2012-2022. In addition, it is seen that most of the studies were published in 2020 (n=65) and there was a decrease in the number of articles after 2020. It is seen that in 2021 (n=63) studies were carried out close to 2020 and 29 studies were published in 2022. It can be said that the low number of studies for this year is since the year has not yet ended. While there is an increasing trend in the number of studies between 2012-2020, it shows a decreasing trend between 2020-2022.

R.Q.2. Distribution of studies by languages

Within the scope of the second research question, the distribution of the publications according to the language in which they were published was examined. As a result of the examination, it was revealed that the studies were written in six different languages and the results of the analysis are given in Figure 3.

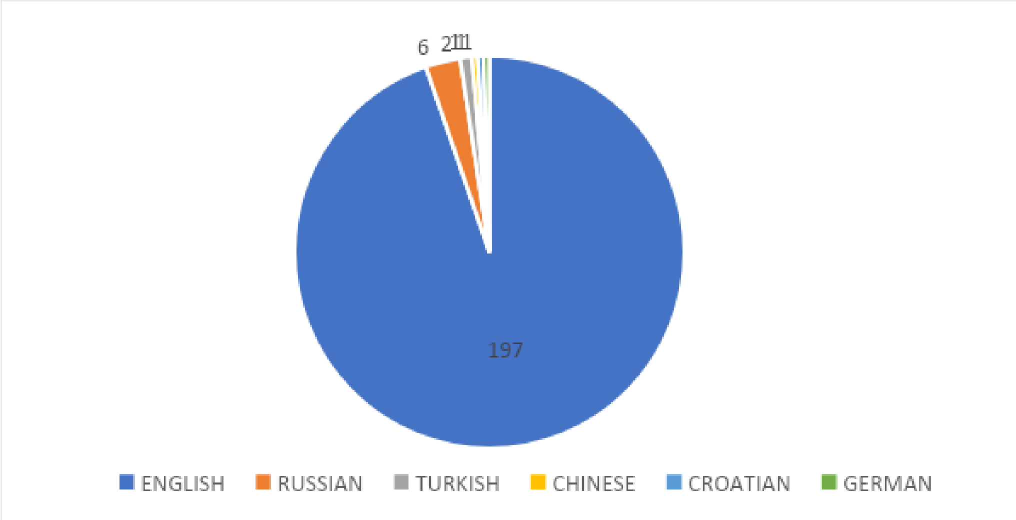

Figure 3. Distribution of studies by languages

When Figure 3 is examined, it is seen that most of the 208 studies were written in English (n=197). Russian (n=6), Turkish (n=2), Chinese, Croatian and German (n=1) are listed as other broadcast languages. It can be said that the lack of diversity with six different languages is due to the fact that the publications are mostly written in English.

R.Q.3. Distribution of studies by publication type

Within the scope of the third research question, an examination was carried out according to the type of publications. In the analysis made in this context, it is seen that the publications are generally published as articles. Detailed results regarding this are given in Figure 4.

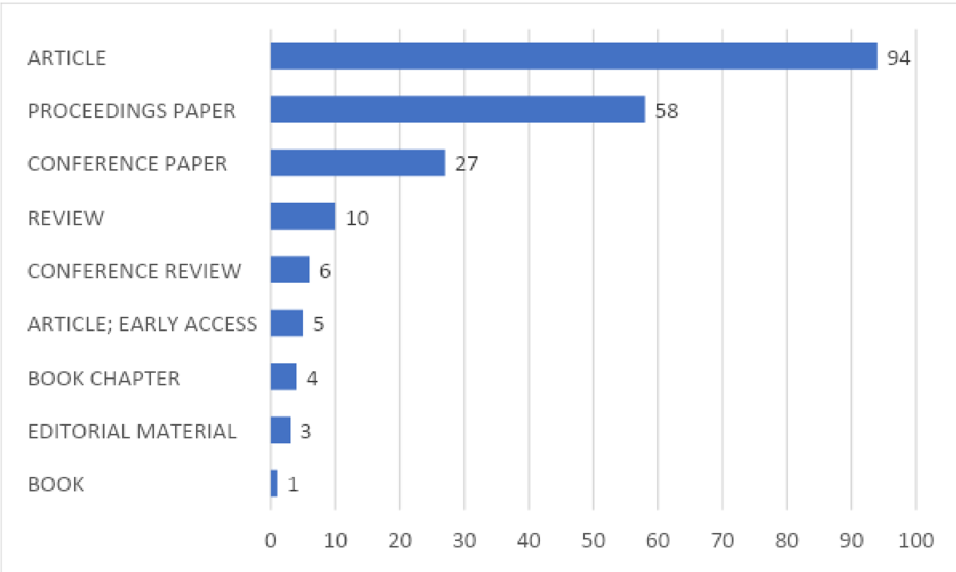

Figure 4. Distribution of studies by publication type

When Figure 4 is examined, the studies were published at least as Book (n=1), Editorial Material (n=3), Book Chapter (n=4), and Article-Early Access (n=5). It was mostly published as Article (n=94), Proceeding Paper (n=58), Conference Paper (n=27), Review (n=10) and Conference Review (n=6). It is seen that there is a tendency to write more articles on this subject.

R.Q.4. Distribution of studies by country

Within the scope of the fourth research question of the study, the distribution of the articles according to the countries in which they were published was examined. In this context, the distribution of publications by country is given in Figure 5.

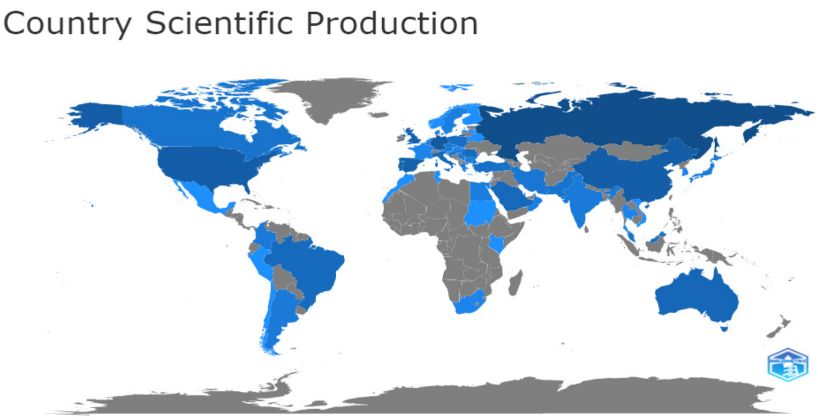

Figure 5. Distribution of studies by country

When Figure 5 is examined, it is seen that the studies carried out are spread over a wide area. This shows that the issue is given importance by many countries. Detailed information on which countries prefer the publications is given in Table 2.

Table 2. Distribution of publications by country

Country	Articles	Country	Articles
Russia	37	Brazil	4
China	13	Hungary	4
Germany	9	Italy	4
Spain	7	Romania	4
USA	7	Saudi Arabia	4
Croatia	6	Turkey	4
Poland	6	Czech Republic	3
Portugal	5	Serbia	3
United Kingdom	5	Singapore	3
Australia	4	Other	76
		TOTAL	208

It was revealed because of the analysis that a total of 208 studies were conducted in 44 different countries and most publications were made in Russia. Russia was followed by China (n=13), Germany (n=9), Spain – USA (n=7) and Croatia-Poland (n=6), respectively. The information on the most cited countries in relation to the countries of publication is given in Table 3.

Table 3. The number of citations of the publications and the number of citations per publication by country

Country	Total Citations	Average Citations	Country	Total Cita-tions	Average Citations
Singapore	127	42,333	Netherlands	9	9
Spain	101	14,429	Hungary	6	1,5
China	69	5,308	Malaysia	5	2,5
Russia	45	1,216	Mauritius	5	5
Italy	36	9	Colombia	4	2
India	35	17,5	Oman	4	4
Saudi Arabia	35	8,75	Serbia	4	1,333
Germany	30	3,333	Argentina	3	3
Brazil	29	7,25	Slovakia	3	3
Usa	22	3,143	Croatia	2	0,333
Australia	21	5,25	Czech Republic	2	0,667
Peru	19	19	Egypt	2	2
Canada	18	9	Korea	2	1
Poland	17	2,833	Austria	1	0,5
Türkiye	17	4,25	Latvia	1	1
Romania	14	3,5	Morocco	1	1
United Kingdom	12	2,4	Pakistan	1	0,5
Vietnam	12	12	Qatar	1	1
Portugal	11	2,2	Slovenia	1	1
			TOTAL	**727**	

In Table 3, the number of citations by country is given. Here, the most cited countries are Singapore (n=127), Spain (n=101), China (n=69), Russia (n=45), Italy (n=36) and India (n=35) respectively. The least cited countries are listed as Austria, Latvia, Morocco, Pakistan, Qatar, and Slovenia with one citation. When the number of publications and citation numbers are compared, although Russia is the country with the highest number of publications, it lags behind many countries in the average number of citations (n=1.2). Singapore, which received the most citations, took the first place with the number of citations per publication (n=42.3) and the total number of citations (n=127), although the number of publications was low (n=3). Considering in terms of efficiency, it is seen that it receives many citations with a small number of publications.

R.Q.5. Most used keywords in studies

Within the scope of the fifth research question of the study, the distribution of the most preferred keywords by the authors in the articles was examined. In this context, the distribution of the most used keywords is given in Figure 6.

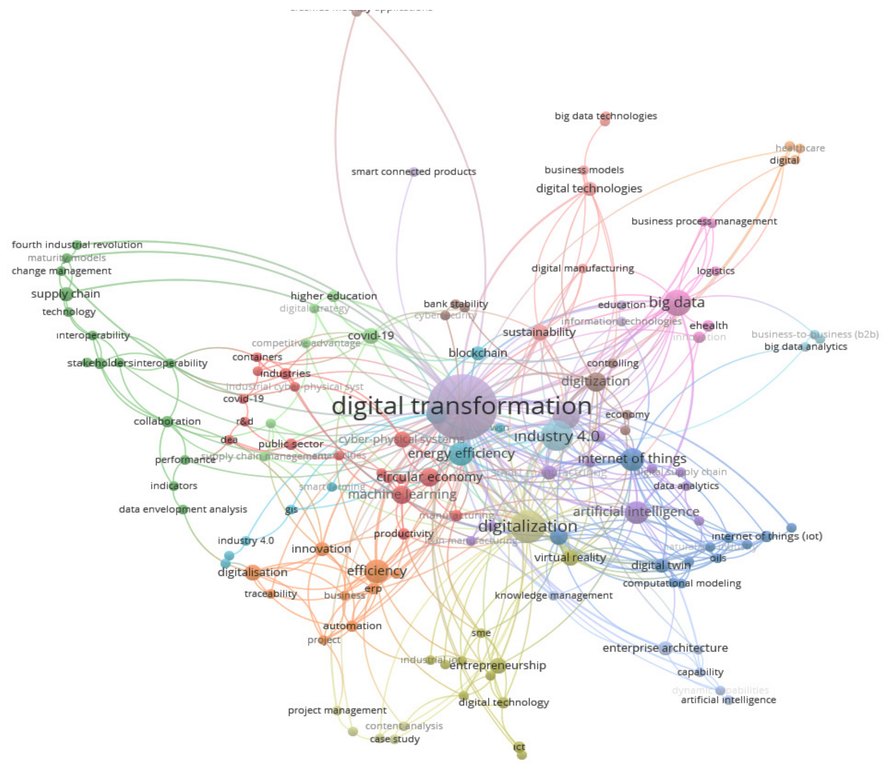

Figure 6. Most used keywords in studies

When Figure 6 is examined, the most used keywords are listed as digital transformation (Occurences"Oc"=59), digital economy (Oc=14), industry 4.0 (Oc=13), digitalization (Oc=11), artificial intelligence (Oc=10), higher education (Oc=10) and internet of things (Oc=10). Some of the least used keywords are virtual technology, university staff, university learning, the effectiveness of scientific research, and technical education. Efficiency keywords were used as Efficiency (Oc=3) and productivity (Oc=3). It has been observed that these keywords are not preferred enough by the authors. This situation can be explained by the low number of publications or the fact that they are not widespread.

R.Q.6. Three-Field Plots

Within the scope of the sixth research question of the study, the analysis of a three-field plot based on the Sankey diagram was carried out. Three-field plot analysis is used to explain the relationship between three different pieces of information (Koo, 2021). In this context, three-field plots were used to visualize the relationship between journal, author, and country variables in the study.

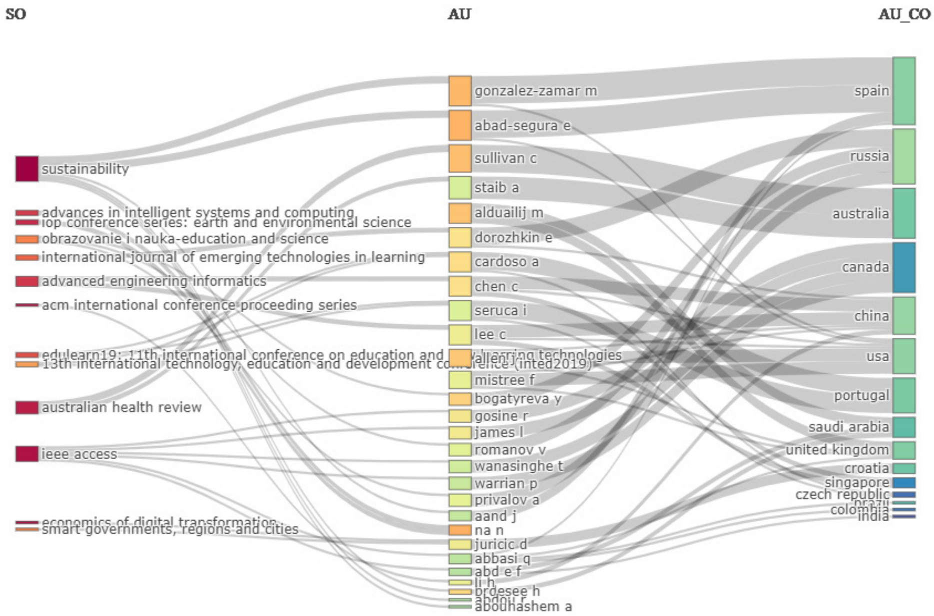

Figure 7. Three-Field Plots analysis in studies

The relationship between the journal (left), author (middle), and country (right) variables is shown in Figure 7. For colored rectangular nodes, the height is proportional to the number of posts in that element. The width of the lines between these nodes is proportional to the number of connections. As the thickness of the lines increases, the strength of the connection increases (Riehmann et al., 2005).

In the figure, 13 journals are listed within the scope of the first variable, the journal. In this list, it is seen the most publications were published in the journal Sustainability (n=11). These 11 studies were carried out by six different authors. Among these authors, Gonzalez-Zamar, M. and Abad-Segura, E. carried out two studies, while other authors published one study each. In terms of the second variable, the author, 27 authors are listed. Authors who have the highest connection power are listed as Gonzalez-Zamar, M. (OC = 12), Abad-Segura, E. (OC = 12), Sullivan, C. (OC = 11) and Stareb, A. (OC = 9). In terms of the countries with the third variable, the countries with the highest linking power were found to be Spain (Oc=27), Russia (Oc=22), Canada (Oc=20) with four authors, and Australia (Oc=20) with two authors.

R.Q.7. Conceptual Structure Map

Conceptual structure mapping was carried out within the scope of the seventh research question of the study. It is used to map the relationship between one word and others to create a conceptual structure map that includes a visualization of the contextual structure of each word, often featured in research articles on higher education and productivity. It is also used to define the conceptual structure of the subject and to define the main themes and trends in an area (Della Corte et al., 2019). The analysis result obtained in this direction is given in Figure 8.

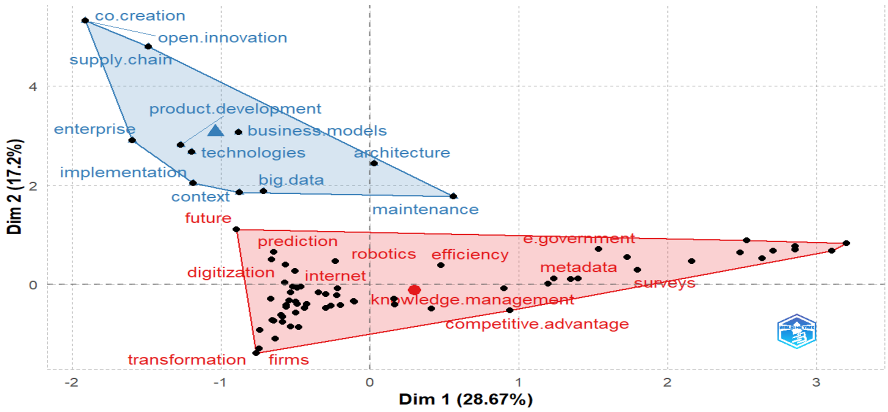

Figure 8. Conceptual structure map of keywords

When Figure 8 is examined, it is seen that two clusters, blue and red, are formed. Each dot in the cluster represents keywords. In addition, since the words are similar in terms of distribution, they are positioned close to each other on the map. There are 11 keywords in total in the "Blue Cluster" on the map. Some of these are listed as co creation, open innovation, supply chain, enterprise, product development, architecture, implementation, big data, and maintenance. This cluster includes technologies, business models and context studies used within the scope of digital transformation in higher education. There are 64 keywords in total in the "Red Cluster". The prominent ones among these keywords are listed as digitization, transformation, internet, robotics, efficiency, prediction, and metadata. This cluster includes technologies used within the scope of digital transformation in higher education, data collection tools, e-government applications, knowledge management and efficiency. When both clusters are compared, it can be said that Red Cluster is more related to digital transformation in higher education.

R.Q.8. Thematic Map

Thematic map analysis was carried out within the scope of the eighth research question of the study. Thematic map is used to show research topics, basic keywords and the relationships between them (Akter et al., 2021). In addition, it is a type of analysis that visualizes four different theme typologies based on two dimensions, Density and Centrality (Farooq, 2022). The result of this analysis used within the scope of the study is given in Figure 9.

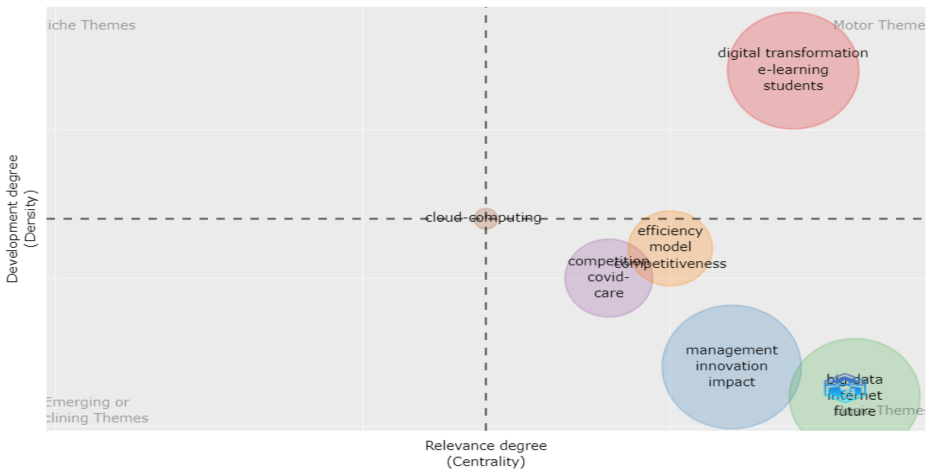

Figure 9. Thematic Map

A theme map based on density (x-axis) and centrality (y-axis) is given in Figure 8. While Centrality measures the importance of the chosen theme, Density measures the development of the chosen theme. As seen in Figure 8, thematic mapping is divided into four parts. The upper right part represents high density and high centrality. The themes in this section are developed and important engine themes. The themes in the lower right part of the map are the main themes and represent high density and low centrality. The themes in this section are developed and important engine themes. The themes in the lower right part of the map are the main themes and represent high density and low centrality. Adequate research has been done on these themes. The upper left portion represents low density but high centrality. These themes are highly advanced and isolated themes. Finally, the bottom left consists of themes with low intensity and low centrality (Wang et al., 2022). In line with the explanations, keywords with high density and high centrality are listed in the upper right part as digital transformation, e-learning, and student. These keywords in a cluster appear as both the most used and the most important keywords in digital transformation in higher education. In the lower right part, some keywords with high density and low centrality; efficiency, model, competition, care, impact, big data, and internet. These keywords have high density and low centrality. However, it can be said that these keywords, which are divided into four clusters, decrease in centrality from orange to green. Finally, the key word that touches all the themes at the center of the coordinate system has been cloud computing.

Conclusion

In this study, it is aimed to examine the trend in the literature towards the concept of digital transformation and efficiency in higher education. In this context, as a result of the literature review, related studies were reached and bibliometric and text-mining analyzes were carried out through VOSviewer and RStudio programs.

As a result of the analyzes carried out, 208 studies were reached. It was seen that the studies were carried out in 2020 with the most 65 publications. 197 of these 208 studies were published in English as a language. Again, it was seen that 94 of these studies were published as articles.

Published studies were found to be mostly from Russia and China, while Singapore and Spain were found to be most cited. The two countries with the highest number of citations per publication were Singapore and Peru. The most used keywords in publications are digital transformation, digital economy, industry 4.0, digitalization, artificial intelligence, higher education and internet of things. In the Three-Field Plots analysis, it was seen that the journal in which the most studies were published was Sustainability, the authors with the most published studies were Gonzalez-Zamar, M. and Abad-Segura, E., and lastly, the countries with the highest connectivity were Spain and Russia. As a result of conceptual structure mapping, it was seen that words close to each other were grouped as two clusters. As a result of thematic mapping, it was seen that the keywords were stacked in the upper right and lower right parts. The fact that the keywords are not stacked on the left shows that the subject is new and there are no isolated concepts. As a result, it has been seen that the study is still new in the examination conducted within the scope of “digital transformation and efficiency in higher education”. Despite the emergence of publications in the last 11 years, it has been observed that the studies were mainly carried out in 2020. This shows that the subject is very new. This shows that there is a need for new studies on the related subject.

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