The Impacts of Digital Transformation

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THE IMPACTS OF DIGITAL TRANSFORMATION

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PREFACE

Science is like a wall that rises above the bricks below. For this reason, I would like to thank the authors of the resources used in this book and all the contributors to the development of the science.

The development of technology and its use in all areas of human life cause transformation. This transformation is effective in many areas such as human life, business processes, ways of doing business, distribution channels, social and cultural values, government processes and etc. This transformation brings both advantages and disadvantages so these affect so many areas. The main purpose in the publication of this book is to draw attention to the effects of the irresistible changes of Digital Transformation.

In this book, there are 9 chapters that cover the different aspects of Digital Transformation written by authors from different countries. I think the chapters will contribute to science and humanity.

With this book, which we have created as a result of a detailed and meticulous study, academics, employees, students and anyone who is interested in digital transformation in the international arena will learn useful information about the changes and the impacts facing the world.

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CONTENT

DIGITAL TWIN MODEL AS A DIGITAL TRANSFORMATION APPLICATION IN PUBLIC AUDITING

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Abstract

With the increase in digitalization access to a large amount of information and data on behalf of public control has resulted in traditional control becoming insufficient over time. This has created motivation for the development of faster, reliable, controllable and continuous control. The purpose of this study is to comparatively analyze the traditional and modern auditing framework. Moreover, the digital twin control applications are proposed as a method that can be integrated into modern auditing.

Keywords: Digital Twin, Public Audit

INTRODUCTION

Following to Industry 1.0, which started in England in the 18th century and applied to new technologies in production area, Alexander Graham Bell invented the phone in 1876 and accelerated the emergence of industry 2.0. The basis of development in industry 2.0 was based on industrialization along with new innovations. After the1960s, in the light of these developments, with the increasing population of cities people's socio-economic demands are diversified to get better public service and make their life easier, as a consequence improvement in computer and digital technologies were required. As a result, communication channels have increased along with developments that have been taking place so quickly in the digital world and making its impact felt in every field. The information sharing network has expanded and the digital period started with industry 4.0 in the early 2000s. Today, this rapid integration brought by Industry 4.0 shortened the decision-making processes by making instant perception of economic and financial data for businesses. The interaction of objects developing together with the digital age introduces radical digital transformations in many areas from service procurement to delivery. Furthermore, as in many fields, it also affects the public auditing and its effectiveness profoundly. It also requires audit in accordance with the modern and contemporary digital world requirements. One of the innovative technologies that have been introduced to our life in recent years is digital twins. The digital twin is making a physical object or process's copy of the real-time data taken from the physical environment into computer environment. It produces decisions with technologies such as machine learning, artificial intelligence and reconstruction of the physical environment with these decisions. This technology promises great contributions and advantages to many institutions and businesses in both public and private sector.

As it is impossible to understand and analyze the effects of digitalization on public audit quality without having profound understanding, to achieve this purpose the phenomenon of digitalization and its process, first of all benefits and usage areas are tried to be examined and solved. Then, along with objects use of internet technology, digital twin management's effectiveness and influences are tried to be proved. In the

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second step, the general framework for public audit in Turkey is explained. Finally, as being unique form of audit's transformation with technology, digital twin tries to focus on causes and consequences of transition from traditional approach to innovative control. As a focusing point of the audit, digital twin highlights "Transition to Modern Audit from Manual Control to Digital Twin Method with Continuous Control Application ".

The purpose of this study is trying to clarify the usage and influence of digital twin method, which is basically one of the advantages of technologic developments, in public auditing. It also tries to provide important contributions to the quality of audit by ensuring the safety of information technologies and data with the help of continuous modern auditing offered by the digital twin.

DIGITALIZATION AND DIGITAL TWIN

Technological advances and digital transformation has opened the door to the digital age in Turkey and all over the world because of having an insatiable desire and hunger for quick access to information. In digitalization era, which is also expressed as Industry 4.0, advances in areas such as artificial intelligence and machine learning, object's internet, major data analytics has been introduced during the transformation and development of technology with the aim of meeting modern needs. As this transition process provides innovations in many different sectors, of course, it rapidly transforms audit in an innovative frame work (Ministry of Industry and Technology, 2019: 8).

Digitalization can be defined as transferring human-created data or workflows into digital environment (Cancan, 2019: 2). Digitization with Industry 4.0 is the process of transforming resources into the optimal results by using the opportunities brought by digital technologies (Book of Proceedings, 2018: 28). Turkey follows innovations offered by digitalization and considers them as policies that can put the country forward in terms of technological point by evaluating it within the framework of the "National Technology Move". It is argued that by enhancing the global competitive power with technology, economic and technological independence will be achieved and social welfare will be carried to higher levels by responding to human needs in the possible fastest way (Ministry of Industry and Technology, 2019: 10).

Statistics show that while only 15 percent of the world economy was digitized in 2005 and it was 22 percent in 2015, 25 percent of the global economy is expected to constitute the digital economy in 2020. Therefore, to be one of the leading countries in the world in terms of technology and demonstrate successful growth, Turkey gives great importance to digitalization (Accenture Turkey Digitalization Index, 2016).

According to the "New Industrial Revolution: Smart Production Systems Technology Roadmap" report, which is prepared by TÜBİTAK in 2016, supports smart technologies that comes with digitalization and studies on this subject; in order for Turkey to catch the world level and going over it, the first seven technological targets are presented in Figure 1 (TÜBİTAK, 2016).

As it can be understood from defined goals pointed out by TÜBİTAK, in order for Turkey to catch the world's technological level, go over it and take its place among leading countries in this area, while technology was previously regarded as a part of human labor in the past, now the notion of technology has been replaced and began to be perceived as an indicator of mind power. Among innovative technological developments which are regarded as indicators of mind power, there are those innovations

that can make human life easier such as major data analysis, virtualization, modelling and simulation, object's internet platform, innovative sensors, cloud computing and cyber security (Ministry of European Union, 2018: 1).

Increasing data processing speed of computer with the digital age and increasing amounts of data with each passing day, have made those innovative technological developments inevitable. Especially, with increasing competition and global integration, all societies from top to bottom have developed and transformed into many different areas that range from portable memory, simulation, and data analysis to self-driving cars with the help of sensors (Cancan, 2019:2). Simulation, a modeling technique, is also shown as among one of these transformations. "Simulation" is a modeling technique that creates infrastructure for monitoring properties of the real system by moving data of a physical system existing in the real world to a cyber-environment. The purpose of simulation is the observation of some scenarios that may occur with warning system via virtual system and minimizing risks and losses (Çelen, 2017: 10-11). "Digital Twin", created by simulations and its advantageous are given by improvements in technology, is an important method with its virtual reality infrastructure. The digital twin is used to analyze and simulate real world conditions in order to respond to changes and improve processes (Engin and Erturan, 2018:815-816).

Digitalization	Major Data and Cloud Computing, Virtualization, Cyber Security

GOAL 1- SERVICE CLOUD PLATFORM, PRIVACY AND SECURITY
Development of the safe, measurable and smart service based cloud platform, applications and algorithm that ensures the privacy of extreme devices
GOAL 2- MAJOR DATA ANALYSIS
Data collection, processing, correlation, analysis, interpretation, reporting and use of decision support systems
GOAL 3- CYBER SECURITY SOLUTIONS
Introducing cyber security applications and solutions in line with the new industrial revolution
GOAL 4- MODELING AND SIMULATION SOLUTIONS
Development of modeling and simulation technologies in line with the new industrial revolution

Interaction	Object's Internet, Sensor Technologies

GOAL 5- INDUSTRIAL OBJECT'S INTERNET PLATFORM
Creating an **internet joint program of safe and secured industrial objects** that can work jointly and integratedly, and developing software for extreme-point units and hardware
GOAL 6- M2X SOFTWARE AND HARDWARE
During the production phases and during the product life cycle, developing appropriate data keeping and storage technologies for data that are generated by the reliable and innovative **M2X (Machine-Human, Machine-Machine, Machine-Infrastructure)** hardware and / or software that will increase quality and efficiency.
GOAL 7- INNOVATIVE SENSORS
Biological, chemical, physical and optical smart actuators; micro-**nano sensors**; wireless, industrial, digital **sensor networks**; image processing, machine vision, **innovative sensor applications**; development of extreme conditions sensors for industry.

Figure 1: First Seven Goals for Turkey to catch the world's technology level and go over it (TUBITAK, 2016).

While simulation with the concept of digital twins builds a bridge between the real world and the virtual world; it is also closely related to technological concepts such as design, data analytics, data mining, objects' internet, deep learning and machine learning. With the help of simulations digital twins, defects that may occur are noticed beforehand and losses in terms of material and time savings can be minimized by timely intervention. In this way, the number of solutions that are reached in response to problems can reach to their maximum level, and they can be solved easily by observing the problem on the virtual product before they occur on the real product (The New Trend of Technology: Digital Twin, Access Date. 05.02.2020).

Within the framework of this study, digital twin method plans to operate holistically with the digital data of "Object's Internet" and "Sensors" of all units which are directly or indirectly related to public audit activity(Sayar,2019: 35).Sensors instantly detect quality of audit activity and make urgent intervention possible in case any failure so that a significant increase in quality can be observed (Ministry of European Union, 2018:1).Therefore, as being a system which creates a digital model for physical machines and foresee what can happen in the virtual environment, digital twin offers the opportunity to examine the quality of process at every stage with continuous audit and constitutes a kind of combination of artificial intelligence and virtual reality with phases such as continuous monitoring and observation of activity (Engin and Erturan, 2018: 817-818).

To determine how objects, work in different environmental conditions and how they respond to created reactions, digital twins compare physical data with real world results. Thus, digital twins provide many benefits on issues such as realizing analysis of real world conditions, responding to changes, determining the problem before it occurs and increasing efficiency by performing analysis of real world conditions (Engin and Erturan, 2018: 816).

PUBLIC AUDIT IN TURKEY

Audit can be defined as an assurance system that determines differences between the actual and the desired goal within certain rules, aims to take necessary measures at points where differences are observed and correct these differences in order to ensure activity's results are carried out in accordance with the predetermined plans and programs (Bozkurt, 2013: 57). In other words, within the scope of public institution audit, auditing is so important in terms of determining whether or not results of administrative activity performed for the purpose of institutions' effective and efficient management, and carried out in accordance with the determined plans(Akyel and Köse, 2010: 10).Having an effective and efficient auditing system in institution will strengthen the financial management and effectiveness of activities by preventing crises that may be caused by lack of auditing(Önen and Özmen, 2011: 93).The audit is carried out by those who carry out their auditing activities independently, and attentive in their duties with sufficient professional knowledge, skills and equipment (Bakan, 2019: 4). In accordance with the requirements of digitalization, auditing should be performed by those who possess technologic skills in auditing in their institutions through using modern methods and computer technologies, in a manner that it is integrated with technology and in a planned way along with continuous monitoring and reporting. In accordance with these objectives, contemporary auditing in Turkey should depend on risk-based perspective and be carried out according to certain priorities. Thus establishment of a transparent and accountable audit system will ensure the efficiency of public auditing and set some clear quality standards for auditing (Polat, 2017:74). In general, public auditing is classified as internal and external auditing in Turkey. When separating them according to their goals, public audit is referred to as internal audit and independent audit.

Public audit

Public auditing which is carried out by official government auditors whose powers are defined by law, aims to fulfill public needs and takes into account the harmony between plans and actual results. In Turkey, the public audit function is seen as supervising process of public institutions, organizations and private sector commercial organizations by audit staffs that are authorized by the government (Bakan, 2019: 4).

In Turkey, there are many audit practices. These audits can appear in various ways such as auditing activities carried out by the government on businesses, tax auditing, commercial auditing and environmental auditing (Savlı, 2019: 21).

Internal audit

Internal audit or administrative audit, brought to public authorities under Law No. 5018, is regarded as a reflection of mindset that is evaluated in the axis of management responsibility principle. Internal audit, part of internal audit mechanism that will be created by management within its own functioning, is a type of audit that carries out as a result of management's spending processes, and thus it shapes responsibilities of administrations. As a matter of fact, internal audit can be defined as determining risks beforehand in order to add value to administrative activities and using obtained performance information to increase corporate performance. Naturally, administration gradually plans efforts to reach strategic goals and targets set by its own internal audit and strategic plan. It tries to minimize risks that may arise through making them predictable. Another important goal of internal audit is providing assurance to top management in order to perform administrative activities on legal basis in accordance with the corporate strategies (Savlı,2019: 49). With the help of this assurance, top management will be able to respond to the responsibilities that may arise from the principle of management responsibility at minimum cost.

External audit (Judicial Audit)

Audition of administrative activities of public institutions by a supreme body outside the institution is conceptually referred to as external or judicial control. Whereas external audits of private sector firms are mostly carried out with external audit firms in the form of independent auditing, external audit of public institutions is carried out by the Court of Account, which takes its power from the Parliament and has a judicial feature in quality. The Court of Account uses its power on behalf of the Parliament and submits its corporate audit reports directly to the parliament to be subject to legislative auditing.

For an effective external audit, the objectives expected from the audit must be clearly laid out, and in order to be reliable, accountable and stronger auditing in global competition, the system must be open to technological development and transition(Bozkurt,2013: 58).Therefore, in today's world where digitalization is at the peak, it is inevitable to adopt a compatible, modern, of high quality, proper for digital age requirement and appropriate audit model in the field of public as in every other field. Thus, data will be analyzed in a safe and transparent manner, and the most accurate results will be achieved (Özdemir and Sağıroglu, 2018:470). However, the importance of auditing in Turkey and why it should be maintained in a manner integrated with technology are better understood with each passing day, when we compare results of manual audit carried out with technology and physical data, and continuous audit model integrated with technology. In order to carry this vision imposed on audit and perform its function in a better way, restructuring should come to the agenda in accordance with those new understandings by performing close monitoring on technological changes experienced in audit approach in Turkey.

TRANSFORMATION OF AUDIT WITH TECHNOLOGY: FROM TRADITIONAL APPROACH TO INNOVATIVE AUDITING WITH DIGITAL

As public resources are limited both in the world and Turkey, some rules and obligations have been introduced to ensure proper usage of those limited resources. These rules, on one hand, have revealed the necessity of auditing, and they've revealed the necessity of quality and effective auditing. Therefore, it is clear that an audit model which is compatible with the necessities of digital world is required to be flexible, sufficient, economic and modern, transparent, accountable, effective, efficient and of high quality (Ertekin,2004: 61-66). As access to large amounts of data has made manual audit inadequate, following to globalizing competitive environment, improvements in technology and spread of digitalization; faster, effective and continuous audit has become an obligation to achieve defined goals (Seçmeli; Orhan, 2016:34).

Continuous auditing is a kind of audit process carried out auditors participating in an audit activity in an electronic environment where it provides assurance by providing reports continuously, it goes on performing by monitoring process with the purpose of shortening the distance between realizations and reporting of the event to achieve simultaneous progress, and adopting a risk-oriented audit to minimize costs (Acar; Öztürk; Usul, 2016:1561-1562).

Synthesized by the continuous audit system carried out within the scope of modern auditing, a digital audit method that will be used in public auditing requires digital twin audit by using information technologies (IT) in this study.IT approach together with continuous audit in the digital twin method, improvement in audit quality affects many transactions, such as documentation, recording, reporting and verification which are carried out in digital environment financially rather than just on paper (Bakan, 2019: 50).

During the audit process that is performed by using the digital twin method, auditing is performed in terms of efficiency and effectiveness in order to provide continuous control over the current situation, and to create and maintain transparency and reliability in transactions (Acar; Öztürk; Usul, 2016:1565). Moreover, according to this system, as most of the data that auditors need to evaluate is already in electronic format, it's essential for auditors' to use technologies to increase the effectiveness and efficiency of the audit. Other important benefits that reveal the necessity of performing an audit in digital environment are as follows (Bakan, 2019: 55-56).

- Savings can be achieved in terms of time usage as it will eliminate the operations on paper manually.

- Calculations and comparisons are carried out more accurate and reliable manner.

- Project information such as time budgets and monitoring of budgeted amounts based on real time can be created and analyzed more easily.

- Cost effectiveness can be increased by expanding and reusing existing electronic auditing practices in subsequent audits and identifying errors in advance through getting advantageous of risk-based auditing.

- The ability to analyze time budget and other types of project control facilitates the quality control system required for all audit functions.

In this context, the comparison of "Traditional (Manual) Control and IT Approach and Continuous Control in Digital Twin Method" is presented in Table 1.

When the audit models in Table 1 are compared, it is clear that digital twin method that enters in audit business with the development of IT outlines a quality and reliable audit. This method aims to provide control and assurance of information by controlling effective and efficient operation of the system in real time(Erturan and Ergin, 2018:822-824).Moreover, in accordance with these purposes, this audit method provides continuous reporting, and workload of digital twin and auditor are reduced by moving physical system data that exists in real world into the virtual environment via sensors, and obtaining and monitoring real system data (Ölekli and Durmaz, 2016: 52).Yet, by having a strong bond between auditor and artificial intelligence technology, the auditors' ability to use smart machines in auditing process and their technological and systematic skills will be included in the auditing process. This will lead to have more transparent and reliable results in order to provide continuous audit that is believed to be more systematic, fast and healthy.

Table 1: Continuous Audit in Digital Twin Method with Traditional (Manual) Audit and IT Approach (Source: Prepared by us.)

Traditional (Manual) Audit	**Continuous Audit in the Digital Twin Method With Information Technologies (IT) Approach**
As it is prepared by real people, financial statement tables prepared by manual method and transactions are more likely to make errors than financial statement tables obtained in digital environment.	There is a risk-oriented audit in which risk situations are pre-determined and corrected by the system. This system aims to reduce possible control risks to zero and prevent them without possible mistakes.
As traditional examinations are likely to be inaccurate, cause to make losses possible because of audit on paper, paper waste is possible, and the total cost spent in audit process will increase.	In continuous audit, possible failures and losses can be prevented by sensors. Labor and cost savings are provided. Possible errors are detected in a virtual environment and their realization is prevented.
As there is a retrospective audit over documents, intermittent annual reporting is generally made manually months after transactions take place and this situation causes temporal losses. Besides, it is more difficult to detect errors and tricks in this traditional audit method.	It identifies errors that may occur through performing audit and risk analysis automatically in a future-oriented manner. It reports them in a short time period and as it is a quick and fruitful system, temporal losses are prevented.
Natural people periodically prepare financial reports and analyse them, therefore it does not provide a comprehensive audit.	Systematic, planned, scheduled and comprehensive audit is carried out to ensure each transaction can be controlled at every stage by using contemporary methods in accordance with requirements of digital age.
Problems may arise in obtaining a proper data set that will ensure the continuity of corporate memory. This situation may adversely affect the audit's compliance of corporate performance with strategic goals and objectives.	As it is possible to provide formation of corporate information memory full time, instant, full-time and reliable information flow can be provided related to the course of corporate performance.
It may not be possible to establish an environment that will enable citizens to develop a sense of trust for their institution about corporate performance.	By recording citizen demands instantaneously, issues that may hinder with the existing sensors can be detected and demands of citizen can be met as soon as possible. Thus, citizens' trust on public institution can be increased.

It is known that there is a higher probability of making errors in manual audit when compared to operations using computer systems. Therefore, even though digital auditing eases the burden of the auditor in the process, if the auditor improves his systematic skill, and can carry out audit process together with digital machines to ensure digital audit, a more reliable audit system can be provided (Bakan, 2019:136). In addition, with the help of digital twin's management, the financial and non-financial data is

uploaded to the digital environment simultaneously, and the rate of benefit and reliability of continuous audit is increased (Ergin and Erturan, 2018:810-812). Thus, through the time it would be a significant deficiency not to create an audit managed method with an information technology approach, which is one of the modern audit requirements in one country. In today's world, as technology has become an undeniable reality that shapes the future; it is inevitable that life will not be sustainable for us if we stay behind the age by not keeping up with transition by interacting with digitalization. In terms of audit world, an innovation will be achieved within the scope of modern sustainable auditing when digital twin method is put into action. That being said, with the help of this method efficiency will be increased in comparison to manual audit (Polat, 2017: 76). For this purpose, with the help of innovative data analysis tools used by digital twins, auditors will always be able to access the necessary information and save time, labor and cost. Higher quality and modern level of auditing will be achieved through continuous audit with the digital twin that is performed automatically (Ergin and Erturan, 2018:820).

In audit process which is performed by the digital twin management, by moving the physical environment into the digital environment through sensors, audit activities will be carried out and internal and external audit will be associated with each other. In ongoing audit processes, reducing the time period to obtain results will increase the quality of auditing by using a holistic and risk-oriented approach. This audit method which is performed through utilizing possibilities of technology sheds light on independent audit institutions 'preparing them for the future. While continuous audit system works effectively, errors that will occur are predetermined by digital twin's tool of smart systems; therefore, precautions will be taken beforehand (Erturan and Ergin, 2017: 26).

CONCLUSION

With the developments experienced during the period known as Industry 4.0, digitalization has caused transformation in many areas; reduced costs in activities carried out and provided time saving. By aiming to provide faster and higher quality services, digitalization has led to new searches in public audit in terms of innovation and effectiveness. The digital age has also demonstrated the need of modern public audit that proposes and supports digitalization in the field of public audit. It has introduced new interaction sites and opportunities for public auditors. Furthermore, it has made available infinitely large data sources that need to be analyzed effectively to make the public auditor more quick and comprehensive. In this study, the usage and benefits of digital twin concept, which is one of these innovations offered by digitalization and corresponds to requirements of digital age, was discussed profoundly in terms of public auditing. Within the scope of this study, I have tried to put forward how to use digital twins as a method of audit in public audits and integrate it into audits by comparing the traditional approach and the modern approach, namely, "Continuous control in the digital twin method with the IT approach". By using the digital twin method in audit, every physical object can be represented with a digital twin, and it will be possible to direct national resources more effectively. With the digital twin, by using contemporary methods in accordance with the requirements of the digital age; a systematic, planned, scheduled and comprehensive audit method that can check every transaction will be carried out. By automatically performing control and risk analysis, electronic information can be accessed in a timely and comfortable manner, thus time losses will be prevented.

By analyzing data obtained as a result of audit, errors will be avoided without causing major problems, time and cost losses through implementing risk-oriented (not error oriented) audit which is applied by a continuous audit method and regarded as a part of the modern audit. In audit without having any vision,

some serious financial losses may occur due to an auditor error or missing and incorrect data. In a risk-oriented and preventive continuous audit activity, which is carried out by making use of the digital twin, continuous control and technological opportunities; evaluation will be provided at every stage and reliable, simultaneous and efficient auditing activities can be carried out with continuous monitoring, control and reporting. With digitalization that entered our lives with Industry 4.0, the number of studies on this subject has increased. Therefore, the subject of contemporary auditing will find its application area and become widespread with every passing day.

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INDUSTRY 4.0: THE CHALLENGES ASSOCIATED WITH THE DIGITAL TRANSFORMATION OF EDUCATION IN SOUTH AFRICA

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Abstract

The study sought to assess the challenges associated with the digital transformation of the education sector in South Africa. The study was premised on desktop research using unobtrusive research techniques which include documentary analysis and conceptual analysis, analysing authoritative sources to conceptualise and contextualise the 4IR and the digital transformation of the education sector. The study discovered that South Africa faces many challenges to fully digitalise the education sector. The challenges that were identified include issues related to inequality in South Africa, the challenge of exclusion, inadequate funding, inadequate skills, and absence of clear, integrative national strategy. The study also discovered that despite the challenges, the digital transformation of the education sector in South Africa can present an opportunity to ensure that universities become innovative and creative hubs at the same time being able to scale up access to educational resources because space will no longer be a challenge. Therefore, the government of South Africa needs to invest more infrastructure that promotes the use of 4IR tools in all institutions. Massive investment in 4IR infrastructure can help to solve problems of inequality, exclusion. The government of South Africa must come up with an integrative 4IR national strategy to ensure that when the sector is transformed, all the provinces move at the same pace.

Keywords: Challenges, Education, South Africa.

INTRODUCTION AND BACKGROUND

Innovations in technology are increasingly impacting on almost every sector in the economy and all facets of humanity and society (Oke & Fernandes, 2020). It is now clear that technology is capable of transforming business and human activities especially the services sector of the economy (Liu & Stephens, 2019). Oke & Fernandes (2020) stated that technology is transforming business and human activity especially teaching and learning. Social media platforms such as LinkedIn and other Massive Open Online Courses are coming up with innovative ways for the dissemination of professional information which includes teaching and learning (Oke & Fernandes, 2020). These platforms are transforming the way teaching and learning information is communicated. In other sectors businesses like Amazon and Uber have come up with technology-enabled platforms that aim to reconcile the demand and supply side of their operations to satisfy customers 'needs and expectations through disrupting the existing business norms and models (Manasia et al., 2020). Also, the social media platforms such as Facebook and Instagram, WhatsApp, and Twitter have changed the fundamental building blocks of our society in the way people interact and socialise (Fomunyam, 2019; Oke & Fernandes, 2020). This shows that technology is transforming all the aspects of humanity to be its economic life and social life.

However, even though the technology is being integrated at an alarming rate in almost all the sectors of our society, its ethical, pedagogical, and epistemological implications on the education sector remain questionable, especially on issues to do with the challenges associated with a complete digitisation of the

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sector and the topical industry 4.0 debates (Manasia et al., 2020). Tymon (2013) argued that despite the advances in technology innovations, the education sector has been lagging in accepting technology to facilitate teaching and learning. This a reality although in the 1980s teaching in technology, science, engineering, and mathematics has been facilitated by robots (Oke & Fernandes, 2020; Tymon, 2013). Oke & Fernandes (2020) also insinuated that the use of technology has been predominantly centred on the didactic approach of teaching where teaching is facilitated with the use of a personal computer as well as the provision of electronic teaching material. However, Oke & Fernandes (2020) believes that the use of digital technology underpinning industry 4.0 is way beyond the use of computer and e-learning materials. The use of digital technology should be compatible with the learner-centred approach for it to be effective in enhancing students learning experience.

It is also believed that the level of technology acceptance in the education sector id relatively low due to its perceived costs, lack of training and limited application. As a result, the effectiveness of technology and its challenges is not well documented in the education sector (Janet, 2010; Manasia et al., 2020). Oke & Fernandes (2020) also argued that to understand the roles and relevance of technology in the industry 4.0 in facilitating teaching and learning practices it is important to have enough understanding of the different components of industry 4.0. Some of the pillars of digital innovation as articulated in the literature include "autonomous robots, simulation, horizontal and vertical system integration, internet of things, cybersecurity, cloud computing, additive manufacturing, augmented reality, and big data and analytics". (Russmann et al., 2015; Schwab, 2017).

Digital transformation of the education sector in education in the industry 4.0 is argued not to be centred only on the use of a computer, but it involves the development of an ecosystem that facilitates sharing of learning materials and data analytics to understand learners and teaching needs (Fomunyam, 2019; Mhlanga & Moloi, 2020a). A study by Kayembe & Nel (2019) on the implications of the industry 4.0 on education discovered the education sector faces several challenges to adapt to the industry 4.0 which include insufficient funding, infrastructure, and skills to prepare graduates to participate in the industry 4.0. In another study by Oke & Fernandes (2020) did indicate that education sector, especially in Africa, is not prepared for the industry 4.0 although there are indications for opportunities to harness the potential of the much-anticipated industry 4.0. The study further discovered that industry 4.0 can facilitate students' learning experiences although there is a requirement, to significantly improve the education curricula and investment in the industry 4.0 technology. Based on the information provided this study is designed to investigate the challenges associated with the digital transformation of the education sector in South Africa in the industry 4.0. The study will also highlight some of the opportunities associated with the digital transformation of the education sector. The rest of the study is organised as follows: the second section explains the industry 4.0, the third section explains the fourth industrial revolutions followed by section five which explains the education sector in South Africa. The brief literature review is explained in section six, section seven explains the methodology. The eight sections explain the challenges of digital transformation while the nine and the tenth sections give opportunities and challenges, respectively.

INDUSTRY 4.0

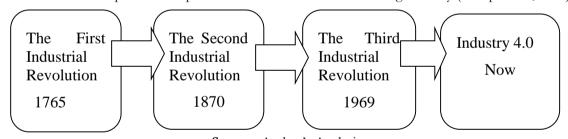The industry 4.0 also referred as the Fourth Industrial Revolution (4IR) is characterised by a "fusion of technologies that is blurring the lines between the physical, digital, and biological spheres" (Mhlanga & Moloi, 2020a; Schwab, 2015). Industry 4.0 is not a prolongation of the third industrial revolution, but it is a new revolution different from the third (Schwab, 2015). The 4IR is unique due to the scope, velocity

and systems impact of the breakthroughs which do not have any historical precedence (Radziwill, 2018). The industry 4.0 is coming in with huge disruptions in every sector of the economy, however, the ability to connect billions of people buy mobile devices with unprecedented power, storage capacity and access knowledge make the revolution more unique (Russmann et al., 2015). According to Erboz, (2017) the industry 4.0 is characterised by emerging technology breakthrough in artificial intelligence, robotics, the internet of things, internet services autonomous vehicles, 3-D printing, nanotechnology, materials science, energy storage and quantum computing. As presented by Kayembe and Nel, (2019) the new technologies are transforming how services, products and materials are produced and consumed.

Oke & Fernandes (2020) stated that the early 1950s marked the foundation of the third industrial revolution, which was influenced by the advances in technology through the first and second industrial revolutions. There are many discourses and interpretations of industry 4.0 on what it means concerning different disciplines or sectors. Some people associate industry 4.0 with technology. Given the education sector, industry 4.0 represents the fusion/amalgamation of the physical, digital, and biological worlds with unprecedented consequences across different educational disciplines. Industry 4.0 is posing significant challenges on how people learn, teach ad work (Manasia et al., 2020).

THE FOUR INDUSTRIAL REVOLUTIONS

History tells us that people have been always depending on technology even though the technology of each era was not of the same size, shape compared to today (Pouspourika, 2019). It is believed people were using technology they had at their disposal to assist them to make their lives easier to perfect these technologies and bring them to the next level. This is viewed as the genesis of the industrial revolutions. Currently, we are in the fourth industrial revolution also known as the industry 4.0 (Pouspourika, 2019). Below is a brief description of the previous industrial revolutions leading to today (Pouspourika, 2019).

| The First Industrial Revolution 1765 | The Second Industrial Revolution 1870 | The Third Industrial Revolution 1969 | Industry 4.0 Now |

Source: Author's Analysis

The first industrial revolution (1765)

The first industrial revolution is believed to have followed the proto-industrialization period (Pouspourika, 2019). The first industrial revolution started at the end of the 18th century to the beginning of the 19th century. This revolution was mainly hinged on the invention of the steam engine which started the major industries in the form of mechanization (Dunga, 2019; Xing & Marwala, 2006). Through mechanisation, agriculture was replaced by the industry as the backbone of the societal economy (Gleason, 2018). In the first industrial revolution, there was the extraction of coal alongside the invention of the steam engine. The invention of steam engine assisted shaping the manufacturing sector and the coming in of railroads which accelerated the economy (Pouspourika, 2019).

The second industrial revolution of 1870

After the first industrial revolution a century later, the world moved on the second industrial revolution (Deloitte, 2018). The second industrial revolution started at the end of the 19th century with massive technological advancements industries that helped in the discovery new sources of energy (electricity, gas, and oil) (Deloitte, 2018; Pouspourika, 2019). The internal combustion engine is a result of this revolution and it reached its full potential in this revolution. Other notable achievements of the second industrial revolution were the development for steel demand, chemical synthesis, and methods of communication such as telegraph and telephone (Pouspourika, 2019). Finally, the inventions of the automobile and plane at the beginning of the 20th century made the second industrial revolution one of the important one (Pouspourika, 2019).

The third industrial revolution of 1969

The third industrial revolution came in in the second half of the 20the century (Pouspourika, 2019; World Economic Forum, 2017). This revolution came in with the revelations of several untapped energy. One of the notable energy resources that were discovered in the third industrial revolution is nuclear energy (Pouspourika, 2019; World Economic Forum, 2017). This revolution came fourth with a rise in electronics, telecommunications, and computers. The new technologies opened doors to space expeditions, research, and biotechnology. Programmable Logic Controllers (PLCs) and Robots assisted in the rise of an era of high-level automation (Davis, 2016; Pouspourika, 2019).

Industry 4.0

Industry 4.0 is the fourth industrial revolution, though some still disagree with this notion (Radziwill, 2018). Viewing the industry 4.0 as a revolution it forces us to believe that the revolution is happening right now. Industry 4.0 started in the dawn of the third millennium with the internet that is used by everyone every day. Industry 4.0 is being experienced every day but the magnitude of it is still unknown. As highlighted earlier the industry 4.0 is characterised by a "fusion of technologies that is blurring the lines between the physical, digital, and biological spheres" (Mhlanga & Moloi, 2020a; Schwab, 2015). Industry 4.0 is not a prolongation of the third industrial revolution, but it is a new revolution different from the third (Schwab, 2015).

THE EDUCATION SECTOR IN SOUTH AFRICA COVID-19 AND DIGITAL TRANSFORMATION OF EDUCATION SECTOR IN SOUTH AFRICA

The education sector in South Africa governed by two national departments, namely the Department of Basic Education (DBE), which is responsible for primary and secondary schools, and the Department of Higher Education and Training (DHET), which is responsible for tertiary education and vocational training (Mhlanga & Moloi, 2020b). Public schools, private schools, early childhood development centres, and special needs schools directly report to the DBE. On the other hand, education, and training (FET) colleges, adult basic education, and training (ABET) centres, and higher education (HE) institutions report directly to the DHET. The other important information is that in South Africa, 97 per cent of schools in South Africa are public and private schools.

The COVID-19 has helped in the transformation of the education sector towards industry 4.0 and the world over. The pressure for social distancing made learning through the conventional face to face impossible in South Africa (Mhlanga & Moloi, 2020b). To make matter worse, the lockdown implemented in the country made learning through face to face difficulties. This pushed the departments of education

partnering with the various private institutions and non-governmental organisations to resort to remote learning using various digital tools, ranging from, televisions, radios, various internet services, social media and mobile applications (Mhlanga and Moloi, 2020).

Table 1: Table of the 4IR tools used during the lockdown (Mhlanga and Moloi, 2020)

Digital tools used during the lockdown in South Africa					
Tools Used	*Description*	*Connectivity*	*Platform*	*Conditions of Use*	*Target Group*
Television (SABC, DSTV, E.tv, Radio (SABC)	Teachers delivering lessons live to learners on TV	Offline	Television Desktop, Radio	Free (lockdown)	Primary Secondary (virtual classrooms)
Use of free zero-rated applications and educational websites Mobile Platforms and applications (Vodacom, Cell C, MTN)	Learners access learning material from educational and informational (reference) websites	Online	Desktop laptop mobile	Free (lockdown)	Primary Secondary Tertiary
Social Media Facebook, Twitter, WhatsApp groups (Sasol Foundation (SF), African Teen Greek, Ms Zora, Siyavula)	Teachers in public and private schools offer classes through a live stream	Online	Desktop Laptop mobile	Free (lockdown)	Primary, Secondary
Internet Websites YouTube, Microsoft teams, Skype, Zoom	Leaners Learn on their own at home	Online	Desktop Laptop mobile	All rights reserved, Freemium, free (Lockdown)	Tertiary Primary Secondary

The table gives a snapshot of the various 4IR technologies used in South Africa during the lockdown. According to Mhlanga and Moloi (2020), these technologies were used in a variety of platforms to combat the effects of COVID-19 on education. Since the study is there to show the challenges associated with the digital transformation of the education sector in South Africa that is shifting from convectional face to face to online learning, definition of some important words like asynchronous learning and synchronous learning.

Asynchronous learning

Wegerif (1998) defined asynchronous learning as the type of learning which happens according to the learner's schedule. In this case, the instructor provides materials for reading, assignments, lectures for viewing and exams. Learning is offered to the learners flexibly as they can satisfy the requirements of the course with a flexible time frame (Wegerif 1998). There are various methods of asynchronous online learning which include self-guided lesson modules, streaming video content, virtual libraries, posted lecture notes, and exchanges across discussion boards or social media platforms (Hiltz, 1997, Wegerif 1998). The World Schwab (2016), 65% of children entering primary school today will end up working in completely new jobs that do not exist yet. This poses threats in the education sector to be ready for 4IR. In South Africa, COVID-19 forced the governments to quickly move from the third industrial revolution in-person instruction type of learning towards asynchronous 4IR educational type of learning.

Synchronous learning

According to Finkelstein, (2006) synchronous learning is defined as learning that happens in real-time. In this case, the students and the instructors interact in a virtual place through various online mediums. With

synchronous online learning, learning happens at a specific time. There are various methods of synchronous learning which includes, video conferencing, teleconferencing, live chatting, and live-streaming lectures. This type of learning in South Africa was necessitated by social distancing is a requirement due to the detrimental effects of COVID-19 through internet and data costs on the part of many students made it possible for this type of learning to be a success (Mhlanga & Moloi, 2020b).

BRIEF LITERATURE REVIEW

There is a lot of growing literature on the industry 4.0 sometimes referred to as the fourth industrial revolution especially its implication on the education sector. In another study, Xing & Marwala (2006) found out that higher education in 4IR is complex, dialectical as well as an exciting opportunity which can transform society. The study further indicated the foundation of 4IR is artificial intelligence which has the potential to transform workplace tasks from task-based characteristics towards human-centred characteristics. In this way, they also argued that machines and man will converge which will reduce the subject distance between humanities and social science as well as science and technology. They further argued that the convergence of between man and machines require much more interdisciplinary teaching and research and innovation

In another study Janet (2010) in a study on how technology is being integrated to improve teaching and learning also discovered that teachers are more likely to try new methods of teaching if certain conditions exist, for instance, professional development and availability of resources. Liu & Stephens (2019) also discovered that due to the technological advancement in industry 4.0 businesses are competing for product, service, and business model innovation. The study also indicated that business sustainability can be attained through firms' internal research and development, and supply chain collaboration.

Fomunyam (2019) in another study assessed the 4IR and tracing the history of educational changes in all the past revolutions with a deep examination of the challenges and implications for engineering education. The study discovered that education changed dramatically during the previous industrial revolutions and in the current revolution many changes are being recorded. Social and industrial transformations in 4IR are defining new trends of development of modern engineering education. The study also highlighted that need for engineering institutions becoming interdisciplinary and producing entrepreneurial engineers. Also, Fomunyam (2019) went further to indicate that industrial cooperation and educational partnership is important to make a trust for future employability and the best engineering education for 4IR. It was also highlighted that partnerships between the society, industry, employers, and the government are critical in education in 4IR.

Manda & Dhaou (2019) also discovered that the advent of the 4IR promises significant social and economic opportunities and challenges which demand that governments respond appropriately. The also indicated that the success of 4IR depends on leadership from all sectors working together to leverage the opportunities and address the challenges of 4IR. The study found out that collaboration between various actors in 4IR is critical in ensuring the success of the 4IR. The study also indicated that for collaboration to take place, trusting relations and cohesion are critical. The study also highlighted that it is important to come up with innovative ways of addressing socio-economic challenges associated with 4IR such as potential job losses, widening wage gaps and skills redundancy.

Manasia et al., (2020) in a study titled pre-service teacher preparedness for fostering education for sustainable development: an empirical analysis of central dimensions of teaching readiness, aimed at

developing a teaching readiness model focusing on education for sustainable development as well as to investigate whether pre-service teachers are ready to foster education for sustainable development through the application of principles to teaching and learning activities. The study found out that knowledge and practice, professional engagement and self-management could be considered central dimensions of job readiness. The study also found out that professional knowledge has a strong and positive impact on teaching practice and professional engagement. The study also discovered that didactic transposition is the most influential component for building professional knowledge.

Oke & Fernandes (2020) in a study on the innovations in teaching and learning, exploring the perceptions of the education sector on 4IR, discovered that the education sector, especially in Africa, is not fully prepared for the industry 4.0 even though there are signs for opportunities to harness the potential of the anticipated 4IR. The study also discovered that 4IR can facilitate the learning process in a way that can transform the workplace even though there is greater need to come up with assessments of the learning environment to better understand the facilitators and barriers to 4IR inclusion. Oke & Fernandes (2020) went further to discover that there are countless opportunities in harnessing the innovations associated with 4IR through research and teaching to enhance learners experience, but they also indicate that a lot of effort is required to improve the education curricula and invest in 4IR technologies.

RESEARCH METHODOLOGY

The study article is premised on desktop research to investigate the challenges and opportunities associated with the digital transformation of education in South Africa. The study used unobtrusive research technique to analyse objectively the challenges and opportunities. The techniques include conceptual and documentary analysis of peer-reviewed journals, reports, and other authoritative documents to establish the challenges of the digital transformation of the education sector in South Africa. Industry 4.0 is a new phenomenon which is currently experienced by humanity, as a result, the study concentrated on secondary research to try and understand the challenges and opportunities of adopting online learning to ensure that the education sector moves with the industry 4.0.

THE CHALLENGES OF DIGITAL TRANSFORMATION OF THE EDUCATION SECTOR IN SOUTH AFRICA

The use of industry 4.0 tools in the education sector in South Africa comes in with a lot of challenges. These challenges need a collective national approach and careful planning to fight them. It is also imperative to note that, the new technologies administered through online learning have the potential to transform the education sector and the lives of the people. However, the challenges associated with this transformation should not be overlooked as they can cause serious harm to the quest to advance the right to education on the people of South Africa.

The challenge of inequality

The first challenge of the digital transformation of the education sector that is switching to online learning is the problem of inequality in South Africa. South Africa is the most unequal country the world over as shown by Zikhali (2018) in one of the World Bank Group (WBG) report. It was highlighted that top 1 per cent of South Africans own 70.9 per cent of the country's wealth while the bottom 60 per cent only controls 7 per cent of the country's assets (WBG, 2018, Zikhali, 2018). In Southern Africa, South Africa

is followed by Namibia and Botswana in terms of inequality (Zikhali, 2018). The other serious problem is that more than half of South Africans (55.5 per cent) or 30 million people live below the national poverty line of R992 per month with the worst affected being black South Africans, the unemployed, the less educated, female-headed households, large families and children (Zikhali, 2018). Introducing 4IR in an unequal society like South Africa has the risk that only the wealthy will have access to the new technological developments for educational purposes leaving the poor behind. Kayembe and Nel (2019) indicated that inequality was clearly shown with the implementation of the other three industrial revolutions where up to now a large proportion of the populations still live without transport, electricity, and internet. As a result, the gap between the "haves" and "have nots" will create further alienation, lack of trust, and social unrest (Kayembe and Nel, 2019). In South Africa at tertiary level, some universities can easily integrate online learning with minimal challenges, for instance, University of Johannesburg has been integrating 4IR in learning even before COVID-19 it is easy for them to shift towards 4IR type of learning. However, other rural universities will find it hard to intergrade online learning due to challenges related to resources and skills. These universities will find it difficult to catch up with other universities forcing them to lag leading to widespread inequality in the education sector (Mhlanga & Moloi, 2020b).

The challenge of exclusion

In South Africa, access to technology especially internet connectivity is unequal and limited (Meyer and Gent, 2016, Kayembe and Nel, 2019). Some groups in South Africa especially schools in remote areas have poor access to the internet and in some instances, they do not have electricity. Digital transformation of the education sector will imply that these groups continue to be marginalized. During the COVID-19 pandemic, various 4IR tools were introduced as a stop gate measure to counter the negative effects of COVID-19 on the academic year, pupils in towns were able to access learning through various platforms which include virtual classes offered by the South African Broadcasting Corporation (SABC) in partnership with the government, some students were learning through Worksheet Cloud Online Lessons, others were accessing learning through the department of education website, zero-rated mobile apps among many platforms. These various initiatives were put to mitigate the disruptions brought by COVID-19 while other platforms were already present before the pandemic. However, children in remote areas were unable to have access to online learning because some do not have access to radios and television, while others do not have access to electricity and internet connection. Even though some lessons majority of rural learners were unable to have access to learning. In a way, these students are being excluded from accessing the basic human right, access to education. Kayembe and Nel, (2019) argued that the gross participation rate of African black and Coloureds in education is lower than white South Africans. Many Black South Africa children and Coloureds have problems of enrolment in mainstream education already. The introduction of online learning in schools will exacerbate the exclusion of Black African children and Coloureds from education if care is not taken (Xing & Marwala, 2018). Measures should be taken to include children in disadvantaged sections of the society to avoid marginalisation of these people.

The challenge of skills requirement and resource constraints

One condition for the successful implementation of online learning through the digital transformation of the education sector is the availability of appropriate skills and resources. According to Butler-Adam, (2018) appropriate skills are required for the full implementation and proper management of the technology associated with online learning. Appropriate skills are important so that the education sector will be able to attain its goal of obtaining the best results from new technology (Kayembe and Nel, 2019). Also, the use of instruction requires coordinated guidelines across the education sector so that there is a

provision of a theoretical foundation for digital pedagogy (Kayembe & Nel, 2019; Xing & Marwala, 2018). Apart from skills in part of the instructors, learners also require extensive digital skills so that they can be able to benefit fully from the resources as they are provided by instructors online. Many kids especially those in townships have challenges when it comes to digital knowledge, for them to benefit more from the programmes. As a result, extensive education and training should be offered to them so that they can also participate.

The following should be taken into consideration for a successful implementation of online learning as outlined by Östlund, (2008), Ekstrand, (2013), Meyer and Gent, (2016), Kayembe and Nel, (2019). Teachers require to learn technology integration strategies and must learn to support students with various needs, Teachers and instructors need to appreciate the role of ICT in education policy, curriculum, assessment and the organisation and administration of education, Collaboration mechanisms should be in place; instructors must have ways of sharing information as it allows them to take ownership of the technology, Training and awareness are required to ensure that ICTs are integrated with the support of pedagogy, in a phased manner., There must be clear goals established to guide learners and teachers in using ICTs in support of teaching and learning. And a large pool of e-skilled educator workforce should be available to improve the quality of education.

Apart from skills, another big challenge that hinders the proper implementation of 4IR in education in South Africa is limited to funding (Kayembe & Nel, 2019; Xing & Marwala, 2018). Over the years, funding in the education sector has been increasing but the budget is not sufficient to fully fund full online instruction (Kayembe & Nel, 2019; Mayer, 2014). Apart from the inadequacy of the education budget, the national government is also spending a lot of money fighting COVID-19 pandemic (Government of South Africa, 2020). The money required to fund the programme such as paying internet subscriptions, buying laptops for students and instructors is huge especially to some small universities. Universities should invest more in new technological advancement and a variety of technical infrastructure as well as the training of instructors. Brown-Martin (2017) stated that one of the biggest costs of the digital transformation of education is the provision of training to instructors and investment in technological infrastructure. In terms of funding, the following should be available as supported by Ekstrand, (2013), Meyer and Gent, (2016). Well-funded, well-managed ICT school environment as the foundation to offer support for teaching and learning with technology, there must a pool of knowledgeable on-site support colleagues to offer technical advice to teachers and learners, security is critical and enough budget to offer time for repetitive training of teachers, to ensure continuity.

Absence of clear, integrative national strategy

The other serious challenge absence of a clear integrative national strategy. The fact that the disruptions in education came a time the national government is preoccupied with the fight of COVID-19 made the process of adopting asynchronous online learning lack the support of the national government even provincial government (Mhlanga & Moloi, 2020a). Where the support is available, it differs from one province to the other. For instance, at the tertiary level, though a kind of collaboration can be deduced from the announcements given, each university is standing on its own (Johannesburg, 2019). This in a way is creating disparities in terms of access across universities in the country (Oke & Fernandes, 2020). The other big issue will be the lack of uniformity across universities and the response to COVID-19 in education was not done from a national government perspective, the response was done by various role players, sometimes in a fragmented manner without targeting all the learners. In this case, learners in rural areas were left out as the programmes introduced since they were targeting students with access to the

internet and computers (Mhlanga & Moloi, 2020b). The absence of integrative strategic direction from the government will make the effort to the digital transformation of education difficult. Apart from ensuring that there is a clear conceptual point and direction at the national level, the following must be considered for the smooth running of online learning. There must be clarity of teaching and learning to teachers and all the programmes should be addressed well, generally, teachers fear uptake ICT more that learners so the programmes should be communicated with clarity, It is obvious that teachers have different levels of knowledge as a result, and sometimes lack confidence, as a result, clear national, provincial, district and institutional level programmes should be put in place and while there are numerous benefits to learners exposing them to ICT, there are also concerns when learners have exposed education in classrooms. As a result, clear goals must be established to which will guide learners and teachers (Meyer and Gent, 2016; Kayembe and Nel, 2019).

OPPORTUNITIES ASSOCIATED WITH DIGITAL TRANSFORMATION OF EDUCATION

Despite the weaknesses presented above, the digital transformation of education in South Africa can present opportunities that did not exist before. Holding all other factors constant, switching to online learning can be an equalizer through improving access. According to Kayembe and Nel, (2019), Mhlanga & Moloi, (2020b) and Oke & Fernandes (2020), the use of technology can resolve challenges associated with social exclusion. Technology can help to bridge the gap between the rich, the poor and even among the different races. Access to education, particularly at a higher education level, has been a challenge due to a limited number of spaces available (Mhlanga & Moloi, 2020b). Many universities are constrained by space; they can take a limited number of students. As a result, despite the challenges associated with online learning, there is an opportunity to scale up access to education for many who were not able to access tertiary institutions. The other important aspect is that technology can present opportunities to promote innovation and creativity, this is in response to South Africa's history of education and political system which was not promoting creativity and innovation as outlined by Kayembe and Nel (2019). The following is a description of the impact of ICT on education as articulated by Meyer and Gent, (2016:16): To build workforces which have ICT skills to handle information and are reflective, creative, and adept at problem-solving to generate knowledge, To enable citizens to be knowledgeable and resourceful so they can manage their own lives effectively and can lead full and satisfying lives, To encourage all citizens to participate fully in society and influence the decisions which affect their lives and, To foster cross-cultural understanding and the peaceful resolution of conflict.

CONCLUSION AND POLICY RECOMMENDATIONS

The purpose of this article was to investigate the challenges associated with the digital transformation of the education sector in South Africa. This is all about moving or transforming the education sector from the third industrial revolution in-person instruction to Online 4IR type of teaching and learning. The study was premised on desktop research using unobtrusive research techniques which include documentary analysis and conceptual analysis, analysing authoritative sources to conceptualise and contextualise the 4IR and the digital transformation of the education sector. The study discovered that South Africa faces a plethora of challenges to fully digitalise the education sector. The challenges that were identified include issues related to inequality in South Africa, the challenge of exclusion, inadequate funding, inadequate skills, and absence of clear, integrative national strategy. They also study discovered that despite the

challenges, the digital transformation of the education sector can present an opportunity to ensure that universities become innovative and creative hubs at the same time being able to scale up access to educational resources because space will no longer be a challenge. Therefore, the government of South Africa needs to invest more infrastructure that promotes the use of 4IR tools in all institutions. On the other hand, the study also noted that the disruptions from COVID-19 should not only act as threats but should act as an eye-opener for the national government to invest more in 4IR infrastructure.

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IMPACT OF COVID-19 ON DIGITAL TRANSFORMATION OF THE WORKFORCE

Dobrica SAVIĆ[1]

Abstract

The outbreak of COVID-19 around the globe forced businesses to innovate and change the way they conduct their work. Offices have become less important and work from home has suddenly become mandatory. This sudden need for work from home is driving the digital transformation of the workforce and the evolution of the work environment at an unprecedented speed. Mass adoption of telecommuting has become a vital business change since the outbreak of the virus. This paper looks at this unprecedented impact of coronavirus pandemic on sudden demand for work from home and the subsequent push for the digital transformation of the workforce.

Keywords: COVID-19, Coronavirus, Digital transformation, Workforce, Work from home

INTRODUCTION

In the past few years, digital transformation has been among the most discussed topics of business leaders and management gurus. Many organizations, while understanding the importance of digital transformation and giving thought to this new trend, have been slow on the uptake to change the status quo, cause potential disruption, and adopt inevitable transformation. Effort has been placed on smaller projects, minor changes, learning from others, and waiting for a more suitable time to make radical change. With the onset of 2020 and the outbreak of COVID-19, organizations found themselves caught off guard and ill-prepared for the new normal brought about by the coronavirus reality. "With millions of people retreating to the safety of the online world for their news, entertainment, education, communication and remote work — the imperative of digital transformation has gone from important to absolutely critical" (The Coronavirus and Public Service Media, 2020).

COVID-19

At the end of December 2019, Chinese health officials informed the World Health Organization (WHO) about a cluster of patients with a mysterious pneumonia. On 30 January 2020, WHO declared the COVID-19 outbreak a public health emergency of international concern. Pandemic suddenly became a household word inundating our daily lives, and the definition — an infectious disease where we see significant and ongoing person-to-person spread in multiple countries around the world at the same time (BBC, 2020)- familiar to all.

Within days of the outbreak, work from home (WFH), until then practiced sporadically by companies and organizations, became mandatory — a question of physical and financial survival. To prevent the spread

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of the virus and protect workers, governments around the world instructed employers to close their offices and enable employees to work from home — to telecommute. It is 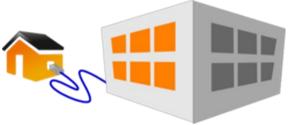estimated that more than four out of five people (81 percent) in the global workforce of 3.3 billion are being affected by full or partial workplace closures (ILO, 2020).

Many, employers and employees alike, had limited experience with WFH on such a large scale before the outbreak. Companies had been comfortable following the standards of office-based work and employees were comfortable with the dichotomy of work and home life. Suddenly companies were faced with the very real possibility of losing revenue and jobs. Combined with the fear and uncertainty of the virus, this disruption was huge, stressful, and painful. WFH was looked on as a potential solution to relieve the pain.

WORK FROM HOME

Work from home, a phrase commonly used since the onset of COVID-19, can be defined generically as employees working outside company offices. It includes four basic characteristics: (1) a person who is an employee of a company or a staff member of an organization; (2) actual work engagement with a company or an organization on specific tasks; (3) work being performed outside the company's physical premises; and (4) telecommunication with the employer.

It is worth mentioning that two other popular terms, often used synonymously to describe work from home, are telecommuting and remote work. The figure below from Google Trends of searches made worldwide in the past three months for telecommuting and remote work, indicates that remote work was used more frequently.

Not only are searches using remote work more frequent, but the availability of information resources mentioning remote work is also greater. There are 24.5 million pages with the term remote work compared to 13.2 million web pages with the term telecommuting. Conversely, Google Scholar offers 50,400 articles on telecommuting and 14,800 on remote work.

Often used interchangeably, remote work and telecommuting have subtle differences in meaning, indicating two somewhat different approaches to the concept of working from home. For the sake of clarity, it is worth defining them in more detail.

Telecommuting is a work arrangement in which the employee works outside the office. This often means working from home or from locations close to home, such as coffee shops, libraries, or co-working spaces (Doyle, 2020). Rather than commuting to the office, employees 'travel' using IT tools, keeping in touch with co-workers and employers via mobile devices, telephones, online chats, video conferences, collaboration platforms, and email.

Allen, Golden, and Shockley (2015) conducted a comprehensive review of a wide range of telecommuting studies and found that most definitions of telecommuting have two things in common: working from a location other than the traditional office, and using technology to perform work-related tasks. They also

identified three areas in which the definitions differ: (1) the extent of telecommuting (e.g., once a month, once a week, full-time), (2) the type of employment relationship (e.g., staff member, independent contractor or consultant, self-employed), and (3) the location of remote work (e.g., home, satellite office, coffee shop) (Allen et al., 2015).

Illustration

1: Google Trends - Frequency of searches for telecommunication (blue) vs remote work (red) from 7 January to 6 April 2020

Benefits of telecommuting for both employees and employers, besides saving money, include increased job satisfaction and productivity, greater flexibility, reduced office costs and requirements, increased staff retention, improved employee work-life balance, keeping older generations in the workforce, and environmental benefits.

However, disadvantages also exist such as sociological and psychological challenges resulting from isolation, long work hours, and lack of separation between work and home. Telecommuting requires self-discipline and dependence on personal IT tools, communication, and other resources. There are also the costs involved for organizations when transitioning to new work methods and training, along with employees' lack of both commitment and identification with organizational culture and values. The increased risk of privacy and security issues should not be underestimated. Some authors also mention the increased danger society faces by creating detached individuals (Harpaz, 2002; Vaganay et al., 2016).

Remote work, another type of work from home, is seemingly synonymous with telecommuting. However, there is a slight difference between these two terms. While telecommuting means working outside the office, usually from home, remote work implies that the employee lives outside the vicinity of the organization's main headquarters or office. This geographical distinction may seem inconsequential, but in fact, it demands change in the management and engagement of the workforce. Managers need to adopt different communication and management styles and make additional efforts to properly lead and ensure the required level of productivity of a remote workforce. Different labor legislation, financial obligations, cultural backgrounds, time-zones, scheduling, and expectations are just some of the dissimilarities between remote work and telecommuting. Often, remote

workers are freelancers and independent contractors who spend their time outside the traditional office settings.

The benefits of a diverse globally distributed workforce boil down to the large pool of specialty professions and the financial gains brought about by different standards of living and local pay. Remotely recruited employees often have considerable financial benefits such as higher salaries, better working conditions, and international exposure.

The disadvantages mentioned above for telecommuting are more or less the same for remote work. However, disadvantages unique to remote workers include their emotional well-being, limited career development opportunities, working outside regular local work hours due to different time zones, professional or even geographical bias, and emotional resentment of co-workers and local colleagues.

DIGITAL TRANSFORMATION

The hard reality of the impact COVID-19 has had on the economy and people's livelihoods has brought the concept of digital transformation into focus. This has especially been the case for the hard-hit workforce. Because WFH has become inevitable, new work models have had to be quickly developed and deployed. Terms such as telecommuting, teleworking, working from home, working at home, working remotely, virtual work, e-work, e-commuting, mobile work, flexible workplace, digital nomads, and freelancing have all been used to describe the current modes of work and to jump start digital transformation of the workforce.

Digital transformation is about doing things differently — creating a completely new business model by using modern information and computer technologies. Digital transformation leverages existing knowledge to profoundly change the essence of the organization — its culture, management strategy, technological mix, and operational setup. It places the customer at the center of all its decisions and actions (Savić, 2019).

The ideas and solutions of Industry 4.0 — digital transformation — have quickly become, for many, a panacea to the COVID-19 disruption. Changing business models and work procedures, maximizing the use of modern information technology (IT), requiring adjustments to organizational culture and behavior, and modifying the expectations and roles of the workforce have become the new rules of the game.

The impact of COVID-19 on the workforce is visible on multiple levels. This includes a change in the nature of work, its variety, volume, velocity, and value. Digital transformation is more than just the

implementation of a new technology. It requires the adoption of a "digital workforce mindset". A digital mindset involves a deep understanding that the power of technology can democratize, scale and speed up every form of action and interaction. The main characteristics of a digital mindset are: abundance, growth, agility, comfort with ambiguity, an explorer's mind, collaboration, and embracing diversity.

Digital transformation of the workforce requirements includes (Savić, 2020):

- Digital literacy, technical knowledge

- Lifelong micro learning and personal development

- Engagement

- Mobile force and remote work

- Generation gap

- Digital ethics

Even before the coronavirus outbreak, the World Economic Forum (2018) estimated that by 2022 over 50% of all employees would require significant reskilling and upskilling. This will be a huge task for HR and other managers, especially since 85% of 2030 jobs don't yet exist (DELL Technologies, 2018).

CONCLUSION

As the ripple of COVID-19 careens around the globe, we are being forced to innovate and change the way we work and live (Marr, 2020). Offices have become less important and work from home has suddenly become mandatory. This sudden need for work from home is driving the digital transformation of the workforce and the evolution of the work environment at an unprecedented speed. of telecommuting has become a vital business change since the outbreak of the virus. And this change is here to stay.

IIn a matter of days, organizations have been required to improve their capabilities for long-distance collaboration. Video conferencing, online purchasing, special deliveries, telemedicine, e-learning, electronic trading, online marketing, video streaming, and many other IT enabled processes have undergone virtual transformation, replacing traditional work practices. Digital transformation covers a wide spectrum, including maximizing the use of modern information technology. Because of COVID-19, it has gained importance and been widely recognized and accepted by both employers and employees.

The recent transformation of the workforce is a crucial step forward for digital transformation. Organizations that have enhanced their IT capabilities and remotely engaged their employees are in a much better position to not only survive these unprecedented circumstances, but to overcome the short and long term challenges that will inevitably follow.

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Work from Home?

Characteristics
- Employer – employee relationship
- Actual work tasks performed
- Work outside company premises
- Communication based on IT

Physical vicinity to company?

NO

YES

Remote work
Employee lives outside the vicinity of the organization's main headquarters or office, often abroad.

Telecommuting
Working from home or from locations close to home, such as coffee shop, library, public place.

24.5 million

13.2 million

Google
search results

14,800

Google Scholar

50,400

intellobics

RETHINKING THE ROLE OF INFORMATION IN THE FOURTH INDUSTRIAL REVOLUTION

Dobrica SAVIĆ[1]

Abstract

The world is at the dawn of a new industrial revolution that will fundamentally change the way we live and work. Many consider this the Fourth Industrial Revolution (4IR). While the First Industrial Revolution (1IR) mechanized production using water and steam power, the second one brought mass production using electric power, and the third one was characterized by automation and digitization, mainly using electronics and information technology.

The 4IR is building upon the third one, but the difference, and its main contribution, is the fusion of technologies that are blurring the lines between the physical, digital, and biological worlds. This is further enhanced by the emerging progress of technology in fields such as quantum computing, machine learning, artificial intelligence, robotics, virtual assistants, the internet of things, self-driving cars, drones, 3-D printing, nanotechnology, biotechnology, traffic and security monitoring systems, and renewable energy. This paper examines the potential impact of the emerging 4IR on information management and the role that the information will play. It is based on analysis of the most prevalent current trends and developments in "cyber-physical systems" that connect machines, computers and people. It will examine the need to rethink the definition of information, its creation, types, processing, sustainability and usability. Given the magnitude of the potential impact of the 4IR on information management, the question is what challenges the 4IR will pose to information managers. One could assume that the acquisition of new knowledge and skills, and the revamping of existing processes and methods will be necessary. Becoming aware of this new phenomenon is only the beginning. It needs to be followed up by professional development and adequate training. Finally, the job of information managers will be to promote and publicize the usefulness and importance of properly curated information, not only for daily work, but also for research and science.

Keywords: Industrial revolution; Information technology; Information management.

INTRODUCTION

The last 230 years, known as the 'industrial age', started with the use of steam-powered machines in textile production and the introduction of the first mechanical loom in 1784. The introduction in 1870 of electrical energy, mass production and assembly lines marked the transition to the 2IR. The second half of the 20th century, brought us computers and electronics, which for many indicated the 3IR. Their massive spread was brought about by an increase in speed and functionality, along with a decrease in price and size. Machines became interconnected, were able to 'talk' to each other, and could do many jobs previously reserved only for people. For many, the introduction of these cyber-physical systems marked the beginning of a new era, the Fourth Industrial Revolution.

Although the 4IR is building upon the 3IR, the difference, and its main contribution, is the fusion of technologies that is blurring the lines between the physical, digital, and biological worlds. The 4IR already

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connects billions of people through powerful communication networks and smart mobile devices, offering access to an immense amount of data and information through high-speed internet access and unlimited storage. This affects our lives, our identities and the way we govern our societies, manufacture products and deliver services.

All of this is further enhanced by the emerging progress of technology in fields such as quantum computing, machine learning and artificial intelligence, robotics, virtual assistants, the Internet of Things, self-driving cars and drones, 3-D printing, nanotechnology, biotechnology, traffic and security monitoring systems, and renewable energy.

This paper examines the potential impact of the emerging 4IR on information management and it is based on analysis of the most prevalent current trends and developments in "cyber-physical systems" that connect machines, computers and people. It does that by looking into the historical content of the 4IR, the various terms used for the same concept, the basic pillars of 4IR and its overall impact on the way we manufacture products, manage companies and processes, and run our daily lives.

It will examine the need to rethink the definition of information, its creation, types, processing, sustainability, and usability. Given the magnitude of the potential impact of the 4IR on information management, the question is what challenges the 4IR will pose to information managers. It can only be assumed that it will demand the acquisition of new knowledge and skills, and the revamping of existing processes and methods. Becoming aware of this new phenomenon is only the beginning. It needs to be followed up by professional development and adequate training. Finally, the job of information managers will be to promote and publicize the usefulness and importance of properly curated information, not only for their daily work, but also for research and science.

In conclusion, the paper summarizes the future of information management, information volume and speed of change, a possible new elements of the definition focused on quality, intellectual property, security, privacy, curation and sustainability, the need for increased knowledge and visibility, and its improved relevance to our work.

HISTORY OF INDUSTRIAL REVOLUTIONS

Around 230 years ago, the world progressed from the agricultural to the industrial age. During the agricultural age, wealth came from the land and farming. With the introduction of technology, namely water mills, hydraulics, steam engines and coal, the agricultural age gave ground to a more superior industrial age that no longer depended on the land. The industrial age started with the use of steam-powered machines in textile production and the introduction of the first mechanical loom in 1784, which marked the birth of the factory. This became known as the First Industrial Revolution. Power from water ran all the machinery in mills that were placed near rivers and streams. This was a great improvement, however, limited mobility, together with the need for a steady flow of water, became a limiting factor for development. The introduction of steam engines, which used coal, was the turning point in revolutionizing the production of iron, railroads, textiles, and the printing press.

The introduction of electrical energy, mass production, conveyor belts and assembly lines, which started in 1870, marked the transition to the Second Industrial Revolution. Steel and petroleum became the major products that changed or enabled many other improvements and developments in transportation,

construction, lightning, communication, and new materials such as plastic. The 2IR, also known as the 'Technological Revolution', lasted until the start of World War I in 1914.

The second half of the 20th century, brought us computers and electronics, which resulted in the digital automation of production using automation and information technology (IT). This, for many, indicated the Third Industrial Revolution. It is often called the computer or digital revolution because it was catalyzed by the development of semiconductors, mainframe computing (1960s), personal computing (1970s-1980s), and the Internet (1990s). (Schwab, 2016). The introduction of industrial robots and robotics affected factories and industrial production.

It should be noted that there are some authors that do not accept the difference between the third and the fourth industrial revolutions, categorizing them both under the Third Industrial Revolution (e.g. Rifkin, J. 2011; Anderson, 2012; Dosi, 2013).

The increase in speed and functionality and the speed of computers, along with a decrease in price and size, brought us to a stage where machines became easily interconnected, 'talking' to each other, 'talking' to humans, and doing many jobs previously reserved only for people. For many, the introduction of 'Cyber-Physical Systems' (CPS) marked the beginning of a new era, the era of the Fourth Industrial Revolution. Robots, intelligence, automatons, the reduction of human labor and mediation via tools, appliances, machines, industrial automation and office automation are becoming widespread (Bloem et al., 2014). Highly intelligent CPS can autonomously perform end-to-end activities along the value chain.
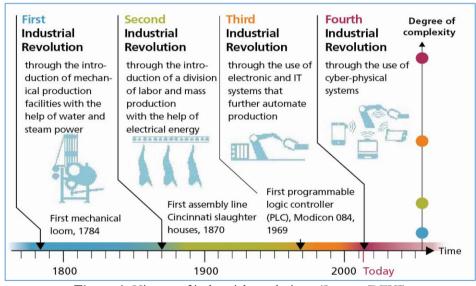

Figure 1: History of industrial revolutions (Source: DFKI)

Figure 1 visually represents the historical timeline of the industrial revolutions, listing the basic characteristic elements, while, at the same time, indicating the degree of complexity.

DEFINITION OF THE FOURTH INDUSTRIAL REVOLUTION

There are several similar terms and corresponding definitions used to describe this new period of industrial development. Some of the most popular are Industry 4.0, the second machine age, the Fourth Industrial Revolution, smart factory, Industry X.0, and digital workplace.

The term *Industry 4.0* originates from Germany's 2011 Hannover Fair. It was a project of the German government to promote the computerization and innovation of manufacturing, in particular the reorganization of the global value chains. The essence of Industry 4.0 lies in a modern and modular structured factory, where physical processes are controlled by cyber physical systems that create a virtual world for making decentralized decisions.

The Second Machine Age indicates a stage when digital technologies (e.g. hardware, software and networks) are becoming more sophisticated and integrated and are transforming societies and the global economy. According to Erik Brynjolfsson & Andrew McAfee (2014), the world is at an inflection point where the effect of these digital technologies will manifest with 'full force' through automation and the making of 'unprecedented things'.

Professor Klaus Schwab, founder and Executive Chairman of the World Economic Forum, is the creator and one of the strongest proponent of studying the phenomena and using the term *Fourth Industrial Revolution*. He believes that we are at the beginning of a revolution that is fundamentally changing the way we live, work and relate to one another. A range of new technologies that are fusing the physical, digital and biological worlds characterizes this new revolution, affecting all disciplines, economies and industries, and even challenging ideas about what it means to be human. (Klaus Schwab 2016).

The Smart Factory or Smart Manufacturing[2] is an environment where machinery and equipment can improve processes through automation and self-optimization. 'Smart', because of the combination of production, information, communication technologies, sensors, motors and robotics, connecting the 'shop floor' to the 'top floor'.

Accenture[3] favors the term *Industry X.0*, the cyber-physical production system that combines communications, IT, data and physical elements. Machines "talk" to products and other machines, objects deliver decision-critical data, and information is processed and distributed in real time resulting in profound changes to the entire industrial ecosystem.

Gartner[4], another major world consulting company, talks about the Digital Workplace which enables new, more effective ways of working; raises employee engagement and agility; and exploits consumer-oriented styles and technologies.

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[2] The National Institute of Standards and Technology (NIST) defines Smart Manufacturing as systems that are "fully-integrated, collaborative manufacturing systems that respond in real time to meet changing demands and conditions in the factory, in the supply network, and in customer needs."

[3] Accenture PLC is a global professional services company providing a range of strategy, consulting, digital, technology & operations services and solutions. www.accenture.com

[4] Gartner, Inc. is one of the world's leading research and advisory companies. The company helps business leaders across all major functions in every industry and enterprise size with the objective insights they need to make the right decisions. www.gartner.com

THE PILLARS OF THE FOURTH INDUSTRIAL REVOLUTION

Just as there are many takes on the definition itself, there are also many opinions about the main pillars of the 4IR. Klaus Schwab talks about three groups of pillars or drivers, namely physical, digital and biological, with each one of them having related products and innovations. The World Economic Forum talks about 13 signs of the Fourth Industrial Revolution[5]. The European Union talks about 'Nine Pillars of Industry 4.0'[6], while the United Arab Emirates launched an unprecedented six-pillar plan to prepare for the Fourth Industrial Revolution[7].

Figure 2 lists some of the major drivers and pillars of the 4IR. It includes big data, artificial intelligence and machine learning, real-time analysis, robots, sensors, nanotechnology, 3D printing, internet of things, numerous smart devices, cyber security and visualization. The most important and fundamental of these are probably processing power, communication speed, artificial intelligence, augmented reality, and robotics.

Figure 2: The Fourth Industry Revolution pillars

The General Impact of the Fourth Industrial Revolution

The prediction is that the impact of the 4IR will be felt by all parts of society and through all of its activities and it will not be a small tremor. Every single activity and every industry will be affected in some way. The three main activities that will be impacted are:

- The way we manufacture products;

- The way we manage processes and companies;

- The way we run our personal lives.

The impact of the 4IR on the way we manufacture products is already present in many of the leading factories and production facilities. It can be noticed through:

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[5] https://goo.gl/pyCK8m
[6] https://industryeurope.com/industry-4-0-the-ultimate-guide/
[7] https://goo.gl/BtzyJF

- Reduced manual labor;

- Increased use of robots, sensors, artificial intelligence (AI) and machine learning;

- Automated supply chain management;

- Reduced level of stock;

- Stronger link between customer demands and production;

- Highly individualized and personalized products.

- The impact on the way processes and companies will be managed is still not perfectly clear, although some indications are already present. They include:

- Horizontal and vertical integration through companies and entire industries;

- Removal of organizational silos, insistence on self-run and self-managed teams, building the 'system of systems';

- Real-time monitoring and planning;

- Introduction of 'lean concepts' (i.e. eliminating anything useless) ;

- Fast response to change and quick delivery using Agile;

- From reactive to predictive mode of operation and management.

- The impact of the 4IR on the way we run our personal lives will be manifested in some, or even all, of the following ways:

- The appearance of the almost omnipresent Internet of Things, including our households;

- The use of smart phones, need for constant communication and danger of spying; threats to our private lives through unauthorized use of security cameras and surveillance equipment;

- Unpredictable growth of society's poor and rich parts;

- Shopping and retail industry (e.g. use of drones and already present online shopping);

- Work environment (remote/mobile work; 24/7 availability);

- Education (e.g. MOOCs, training for jobs vs. training for skills);

- The open access movement (e.g. the role of intellectual property, open science, crowdsourcing).

"The challenges are as daunting as the opportunities are compelling. We must have a comprehensive and globally shared understanding of how technology is changing our lives and that of future generations, transforming the economic, social, ecological and cultural contexts in which we live." (Schwab, 2016).

Impact of the 4IR on the Information Management Concept

A valid question to ask is one about the current use and the importance of information management, not as a type of activity, but rather as a topic of research itself. In other words, is information management still a subject of scientific study and research? A quick look through ScienceDirect[8] using the phrase "information management", results in over 41,000 hits. As Figure 3 shows, the number of articles that either deal with or mention information management had remained steady in the last 15 years. Annually, there are between 1000 and 2000 new articles added. On the other side, Google Scholar lists almost 2.3 million articles mentioning information management. This is a good indication that interest is there, and that further exploration of the future and the role of information management in the 4IR is important and needed.

There have been many attempts to define the term 'information' and the related concept of 'information management'. However, it is challenging to come up with a widely accepted definition since all attempts highlight different but valuable aspects, and they all have different connotations in different contexts. Almost every scientific discipline today uses the concept of information within its own context and regarding specific phenomena (Capurro & Hjorland, 2003).

Oxford dictionary defines information as **facts** or details about something or somebody[9]. Merriam-Webster dictionary defines it as **knowledge** obtained from investigation, study or instruction[10]. Wikipedia defines information as **data** in context and with meaning attached[11]. For behaviorists, information is **stimuli** that has meaning in some context for its receiver[12]. Other authors vie information only as a human phenomenon where individuals are transmitting and receiving **messages** in some contents (Kornwachs & Jacoby, 1996).

Buckland (1991) looked at different uses of the term information in information science and concluded that word information can be used about things, about processes, and about knowledge, emphasizing four aspects of information (intangible, tangible, entity, process). His final remark was very instructive — "We conclude that we are unable to say confidently of anything that it could not be information".

Since it is difficult to precisely define information, it is even more difficult to define information management. It can cover management of facts, data, knowledge, or even management of communication

Figure 1: *ScienceDirect search results*

41,111 results

Set search alert

Refine by:

Years

- 2021 (3)
- 2020 (1,737)
- 2019 (2,171)
- 2018 (1,872)
- 2017 (1,916)
- 2016 (2,068)
- 2015 (2,002)
- 2014 (1,973)
- 2013 (1,806)
- 2012 (1,765)
- 2011 (1,661)
- 2010 (1,444)
- 2009 (1,462)
- 2008 (1,361)
- 2007 (1,322)
- 2006 (1,200)
- 2005 (1,011)

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[8] http://www.sciencedirect.com/

[9] shorturl.at/GHTU0

[10] shorturl.at/lmvGT

[11] https://en.wikipedia.org/wiki/Information

[12] shorturl.at/dvRUY

processes between humans or between computers. If viewed only as communication between humans, a whole area of computer applications could be eliminated, so that is not an approach often promoted. Majority of data scientists subscribe to the view which gives highest importance to managing and manipulating data through the use of computers and other modern information technologies.

The fourth industrial revolution with its predominantly IT based tools, intense use of robotics and automation, pushes classic information management aside, diminishes its value, and concentrates on data processing heavily dependent on mathematical and statistical processing techniques. More emphasis and more importance are being placed on data management than on information management. Quite often, data management completely engulfs what was previously regarded as management of information into this new trend but widespread trend. How lasting and extensive this trend will be, remains to be observed.

Impact of the 4IR on Information Management

Wayne Balta, Vice President of the IBM Corporation, in his presentation regarding IBM's concept of 'smarter planet' and the role of big data and sustainability (Balta, 2014), talked about three defining attributes that arise from the foundation of data. According to him, the world is becoming:

- **Instrumented** (ability to measure, sense, and see the exact condition of everything);
- **Interconnected** (people, systems and objects can communicate and interact with each other);
- **Intelligent** (we can respond to changes quickly and accurately and get better results by predicting and optimizing for future events).

As pointed out by John Naisbitt[13], "We have for the first time an economy based on a key resource [Information] that is not only renewable, but self-generating. Running out of it is not a problem but drowning in it is". He went further to stress that, "We are drowning in information but starved for knowledge". Following on Naisbitt's thoughts, Wayne Balta (2014) developed a system of Four Vs of big data (Figure 4), which is important in understanding the role of information management, specifically having in mind increasing volume of information and data, great variety, speed of information creation and dissemination, and particularly important the truthfulness.

Challenges brought by 4IR to information management are already multiple and will get even more concerning and more difficult to resolve with time. The major ones include:

- *Data flood*

More and more data, less and less information and subsequent knowledge.

- *Computer-centric decision-making*

In order to process, manage, and use large amounts of data, organizations and decision makers will depend more and more on machines, machine intelligence, machine learning, and larger impact of artificial intelligence on decision-making.

- *Lack of trained human resources*

Proper training matching the workplace demands, quick retraining, mobility.

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[13] https://en.wikipedia.org/wiki/John_Naisbitt

- *Innovation slow-down*

Growing demands for constant improvements, creativity, and change might reach an impasse due to lack of motivation, detachment, and disinterest of employees who might feel being irrelevant in the world where everything is already discovered.

- *Information reliability*

Loss of trust in available information resources and decisions based on them.

- *Lack of organizational culture*

Remote work, quick and unexpected changes, loss of direction and guidance, problems with ethics and corruption.

Figure 4: Big data (Source IBM, Balta, 2014)

Impact of the 4IR on Information Management Sustainability

The above-mentioned four Vs are also important for the long-term sustainability of information management. The Oxford dictionary defines sustainability as "the ability to be maintained at a certain rate or level." However, the most famous definition comes from the Brundtland Report (1992) that states "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainability of information management can be examined from three main aspects:

- Environmental/technical

Long-term preservation; organization and management; operability;

• Economic/Financial

Level and duration of support; Return on Investment (ROI); future value;

• Social/Organizational

Audience; information ownership & governance; freedom of access to information.

Each of the aspects mentioned here represents, by itself, a research topic. For this paper, it should be enough to note that sustainability represents one of the major challenges to the future existence and the use of information management. Without functional sustainability, there will hardly be future for professional information management.

Impact of 4IR on Information Usability

Closely connected to sustainability is information usability. Designing the means, tools and methodologies for the future use of information could become a breaking point for further industrial and social interest and in investing additional efforts to secure, process and maintain vast amounts of data and information. If its future usability cannot be guaranteed, there will not be much concentrated effort to do anything with it at the present. Therefore, the question of usability needs to be examined from the following angles:

- **Tools for analysis**
  Old vs. new technological tools and methodologies; different software functionality, concepts, expectations; dynamic vs. static information and documents;
- **Visualization**
  2-D and 3-D; virtual reality (VR), augmented reality (AR), and mixed reality (MR); requirement levels and technical skills for creation and use of massive data and information;
- **Intellectual property**
  Over protectionism vs. open access and open science; doubts about protection of intellectual property helping world development, health, and innovation;
- **Information security**
  Measures in place to keep data and information secure from unauthorized access, theft, modification or destruction; cybersecurity of both hardware and software; long-term preservation;
- **Privacy**
  Protection of sensitive personal information; CCTV cameras in public; social media photos.

Tools for future interoperability, processing, analysis and presentation of information, especially data and data sets, are a breaking point for its long-term sustainability and usability. However, intellectual property and rising concerns regarding privacy protection could also become major detrimental factors for the future of information management.

CONCLUSION

In the last few decades, developments in information technology have had an immense impact on the way we manage information in general, particularly on the way we create, disseminate and use it. Based on the review of the 4IR and the related developments already in place, it can be concluded that information management will not disappear in the future, that the volume of data and information will experience

exponential growth, and that the need for proper and more advanced information management tools and mythologies will increase.

Taking into consideration the volume and speed of information creation, there seems to be a need to revisit the old definition of information management by refocusing on quality, intellectual property, curation, sustainability, usability, security and privacy. The most important, and probably the most critical step, is to work on finding the most appropriate role for information management in supporting decision-making and providing proper training and guidance to people directly responsible for it.

In order to increase knowledge, visibility and relevance of information management, more work needs to be done on theoretical research and practical applications; on the development of proper training courses and tutorials; on establishing cooperation among data and information specialists, librarians and archivists; on promotion; and on efforts to demonstrate the value of properly managed information collections and data repositories.

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DIGITAL ECONOMY AND DIGITAL TRANSFORMATION IN THE REPUBLIC OF NORTH MACEDONIA: CURRENT STATE AND OPPORTUNITIES

Elizabeta TOSHEVA[1]

Abstract

Digital technologies provide opportunities for inclusive and sustainable economic growth in all sectors of the economy and society. The EU countries regarded digitalization as the main driver of competitiveness, economic development and employment growth. The main goal of the development of digital infrastructures is to ensure that all citizens (including socially disadvantaged population groups) regardless of their location or place of living can use digital opportunities without any technical, organizational and financial restrictions or difficulties. Digitalization should be carried out through the economic growth by increasing the efficiency, productivity and competitiveness of the use of digital technologies, which implies the digital transformation of economic sectors, areas of activity, as well as the acquisition of new competitive qualities and properties. In our research, we used a deduction method to determine global trends in the digitalization, an institutional analysis to identify the objects of regulation of public life digitalization through the concrete examples and evidence in relevant institutions, information synthesis methods to indicate the penetration of digitalization in the institutions, as well as analysis of the economic and social benefits of the users in terms of business efficiency, relying on the results obtained from the research carried out in the selected companies and institutions in the Republic of North Macedonia.

Keywords: Digital economy, institutions, digital technologies, North Macedonia.

INTRODUCTION

The concepts of "digital technologies" and "digital economy" were introduced into the scientific dictionary due to the technological changes of the 21st century regarding the "merging" of telecommunication, information and communication technologies and innovations. The concept of digital economy is evolving all the time because of its multifaceted and dynamic nature and due to the transformational power of digital technologies. Currently, digital technologies are transforming the relations between economic actors in energy, construction, banking, transportation, retail trade, education, healthcare, the media and security.

Information and communication technologies today play a key role in modern society's development. Today, people around the world rely on mobile communication, internet access and social media for interactions with each other, sharing information and obtaining new knowledge and services, while governments and businesses increasingly prefer the internet for disseminating information, delivering services, communications, marketing and doing business in general. They have become an essential tool in the daily lives of citizens, increasing the importance of these technologies in a rapid trend over time (*Ministry of Information Society and Administration, 2011*). Every company or institution communicates with its environment which consists of users and customers, prospective buyers, suppliers, state, competition and more. For the survival of the organization, the most important thing is the communication that makes it with users or customers. The competitiveness and efficiency of companies and institutions increasingly

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depend on the capabilities of electronic programs and electronic communications. Information Technology (IT) has been considered as one of the most important components in the current business environment, offering opportunities for companies that successfully take advantage of its benefits (*Albertin, & De Moura, 2004*).

Effective communication is one of the key elements of any business's success. In the area of data exchange broadband technology has led to a significant improvement. The term broadband itself is used to describe high-speed Internet connections, that is, those that allow sites to open without much waiting, and emails to be sent and received quickly, with the possibility of large amounts of data being sent in addition to email. Private and public sector employees can communicate via email which directly reduces the cost of telephone and postal services.

The functioning of each element inside and outside the organization is conditioned by the nature and the system of communication. Communications are an essential tool for directing and controlling the work as well as the actions of people, individuals, and groups in the organization.

In this way, companies realize significant savings in operating costs, perform their tasks more efficiently, and become more competitive in the market. Participants in the business operation are governed by the general rules, but the business technology changes. Computers are used for easy and smooth realization of growing number of business transactions; they replaced paper, pens, and stamp. The one who wants to be successful at the local level must also meet the criteria of global competitiveness because the new knowledge-based economy does not know the geographical barriers or the boundary (*European Commission, 2003*).

Electronic communication involves doing business processes with the usage of electronic technology. On-line communication means usage of various communication technologies to pass and receive information online (*Bodo, 2003*). Digital technology facilitates the combined use of information and communication technologies allowing the sending of large amounts of information over long distances in a short period of time. The development of the Information Society should be based on partnerships between government, civil society, the private sector, operators, local governments and the other stakeholders. Sustainable economic development is a benefit of the development of the Information and Technology Society, but at the same time, it is the driver of that process (*Ministry of Transport and Communications, 2005*). It is also an important factor in the early stages when creating a critical mass of stakeholders dedicated to the development of the Information Society.

Due to limited natural resources and poor export competitiveness produced mainly in the labor-intensive branches of the economy, Republic of North Macedonia as one of its strategic commitments for its own rapid economic development, it has been clearly identified the power of human potential and the capital of knowledge to direct and use as one of its strongest support in fulfilling its purpose. This corresponds to the priority to accelerate economic growth while providing equity (in satisfying the needs and solutions to the challenges that people face, both in urban and rural areas, different ethnic communities and equality in the right of access information) and ultimately poverty reduction (*Ministry of Finance, 2019*).

Full access to electronic communications infrastructures and information technologies ensures balanced economic development throughout the country, i.e. polycentric development that contributes to good decentralization of local self-government units, building transparent and accountable local administrations, culminating in a gradual decline of the digital divide within the state. At the same time,

this leads to the relativization of borders and increased cooperation and dialogue within the Euro-region (*Ministry of local self-government, 2015*).

The purpose of this paper is to show the economic and social benefits of the users of products and services in terms of business efficiency through the concrete examples and evidence, as well as from the results obtained from the research conducted in the selected companies and institutions in the Republic of North Macedonia.

THE DIGITAL TECHNOLOGIES FOR BUSINESS EFFICIENCY AND EFFECTIVENESS

Information and communication technology (ICT) enables globalization, as the opportunity to promote local products globally, i.e. equal participation in the global networked economy. Those who have been isolated, or have been "invisible," so far have been given a voice, by giving them the opportunity to freely express themselves regardless of their economic status, gender or location of residence (*Ministry of Transport and Communications, 2005*).

Electronic business methods enable companies to link their internal and external data processing systems more efficiently and flexibly, to work more closely with suppliers and partners, and to better satisfy the needs and expectations of their customers. E-business allows for conversations to happen quickly, faster decision-making saves time, and time is money in business (VIT, 2010.)

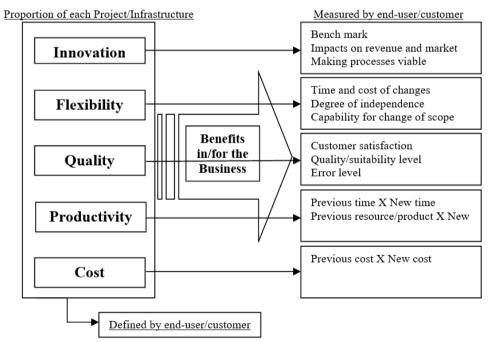**Figure 1:** Benefits offered by the use of Information Technology (Albertin and Moura, 2004).

Innovations in electronic communications technology spurred the Information Age, a time period featuring fluid, almost instantaneous information transmission. The digital world offers interfaces such as email, instant messaging and chat rooms that help with the simultaneous transference of information to a

large number of people. For many organizations, electronic communication has become a necessity for participation in modern commerce. Electronic commerce has opened up many opportunities because it allows large-scale global collaboration (Blalock, 2005).

Digitalization as an object of focus for achieving integrated public administration. The main objectives of the state towards digitalization are to correct the shortcomings of market mechanisms, overcome institutional and legislative barriers, attract relevant investments, stimulate the development of digital infrastructures, create needs for the use of digital technologies by the population and develop the corresponding digital competencies necessary for digital entrepreneurship.

Albertin and Moura, (*2004*) state that the benefits of IT can therefore be defined as cost saivings, productivity, flexibility, quality and innovation; these benefits can be understood as "a present" that this technology gives to the organizations. However, just as important as the present is how it is taken advantage of it in relation to business performance. *Figure 1* shows these benefits and gives examples of how they are measured.

Having regard to the foregoing, strategic use of the ICT in business could bring benefits in several areas:

- **Support Innovation.** Organizations that want to improve their innovation capabilities and develop new products or services for the market can use cloud computing to speed up the process. This provides an important strategic advantage by enabling the organization to get new products to market quickly, ahead of the competition.

- **Improve Responsiveness**. Cloud computing enables organizations to scale up their IT resources quickly in response to changing market conditions. Organizations that offer products and services online may find it difficult to handle a surge in traffic, which could result in lost business. Adding resources from the cloud provides a strategic advantage by enabling them to respond to changes in demand, increase revenue and maintain customer satisfaction.

- **Increase Collaboration.** IT solutions that improve collaboration in an organization can provide an important competitive advantage. Issuing field service teams with smartphones, for example, enables service engineers to provide a faster, more efficient service to customers. Engineers working on a customer site can set up voice or video conference calls with product or technical experts at headquarters to discuss and resolve a complex issue, rather than delaying a repair. Offering customer superior service provides a strategic advantage by differentiating an organization from competitors.

- **Enhance Customer.** Insight collecting and analyzing data to gain greater insight into customers' needs and preferences provides a strategic advantage. By using powerful analytics software, organizations can develop customized offers and personalized communications that help to increase customer satisfaction and foster loyalty.

- **Introduce New Business Models**. Organizations can use IT to make strategic changes to their business models. A company that traditionally sold products through retail outlets might use IT to develop an e-commerce model that enables it to reach a wider market, reduce its distribution costs and offer a more convenient service to customers *(Linton, 2019)*.

It is important for countries to undertake structured efforts to create and harness the benefits of digital economy in order to realize greater job creation, increase country competitiveness, allow for greater diversification and catalyze innovations in service delivery to improve the lives of their citizens.

COVID-19 CRISIS AS AN ACCELERATOR FOR DIGITAL TRANSFORMATION AND DIGITAL ECONOMY

The COVID-19 pandemic shows that digital connectivity is critical to societal resilience and business continuity in times of crisis. Since the onset of the COVID-19 crisis, internet usage has risen by 70%, the use of communication apps has doubled, and some video streaming services have seen daily usage raise 20-fold (WEF, 2020). Without any doubt, the COVID-19 pandemic has a catalyzing effect on the digitization of businesses as well as government related services and internet usage by consumers. Business models are being disrupted while the digitalization of the economy is accelerating as new technologies and services serve a reshaped workforce. As a result, the competitive landscape has changed already - new businesses have been founded, some small players have grown their influence, some went down-and-out. Now more than ever business is looking to technology to be agile in the face of disruption and create new digitally enabled business models for the post-COVID "new normal." Diverse domains such as telecoms, digital media, healthcare, e-commerce, banking and contactless payments are experiencing dramatic changes. Within this context, digital technology has the transformative potential to maintain a functioning economy and allow people to access the basic services needed for everyday life, such as education, health, work, access to information, and communication with competent authorities during this time of pandemic. It, however, must be applied in a manner that respects the digital rights of all (UCLG, 2020).

While digital technologies can significantly aid in containing the pandemic and minimizing the social and economic impacts, with special reference to women and men who are frontline health workers, self-employed and carers, the unfolding crisis will have a bearing on the global economy and reinforce the significance of the digital economy. This requires a swift and coordinated response on a number of important policy issues across the entire spectrum of the digital domain. Governments could take the opportunity to invest in large scale up and re-skilling programmes in digital technologies and digital literacy. Local authorities should identify the exact needs and develop effective training in collaboration with business associations, businesses, chambers of commerce, education institutions and training providers.

The lockout measures during the pandemic and the need to reduce direct social contacts have also opened up new potential for digital commerce and the digital economy. Due to the development of virtual platforms and digital supply networks, it has been possible to bring together the supply and demand in die rent sectors of the economy and to provide security of supply for both parties. Therefore, it is necessary to improve the e-commerce environment globally and enhance the capacity of all stakeholders to take advantage of its possibilities. Digitalizing health data, telemedicine, digital patient portals, electronic prescriptions, electronic health records, using robots, modern information systems of hospitals etc. would help take health systems to a new level. Distance learning platforms, digital databases and digital textbooks, e-learning materials and digital examination solutions would enable the continuation of normal communication between students, teachers and parents.

Equitable access to digital infrastructure has never been more important than now. Technology has proved a useful and necessary tool to help ensure that local and regional governments on the frontline of the emergency continue to provide essential public services during the COVID-19 crisis. Local and regional governments on the frontline of the COVID-19 crisis have resorted to digital technologies to monitor, anticipate and influence the spread of the disease, as well as to provide education for students. E-governance makes public services available remotely and constantly, therefore helping people and

businesses carry on their activities during the crisis. More broadly, e-governance supports efficient, accountable and inclusive public institutions that are vital for addressing the long-term effects of the pandemic. It also improves the business climate and saves time and money.

Among the many trends that COVID-19 has accelerated, two stand out: calls are rising for companies to lead in addressing societal challenges, and the marketplace is indicating that companies must adopt digital business models at their core to compete.

INFORMATION AND COMMUNICATION TECHNOLOGIES IN THE REPUBLIC OF NORTH MACEDONIA

The strategic approach of the Republic of North Macedonia to the legislation and electronic communications regulation

According to the data of the State Statistical Office, in the first quarter of 2018, 79.3% of the households in North Macedonia had access to the Internet at home. The participation of households with fixed broadband connection in the total number of households is 70.4% in 2018. In the first quarter of 2018, 79.2%% of the total population aged 15-74 used the Internet, and 68.7% used the Internet every day or almost every day. Mobile phone or a smart phone was the most used device for access to the Internet, by 81% of Internet users in this period, and mostly among persons aged 15-24 (91.8%). 74.9% of the people used computers, laptops, smartphones, tablets or other portable devices at work. 31.6% of the people who used the Internet ordered/purchased goods or services over the internet in the last 12 months, and the majority of them (54.9%) bought clothes or sports equipment.

According to the data of the State Statistical Office of the Republic of North Macedonia (*SSO, 2018a*) in 2018, 94.4% of the enterprises used computer in their work. 81.5% of the enterprises with 10 or more employees had the fixed broadband connection to the Internet. From the total number of the enterprises 53.9% had website/homepage. From them, 89.6% provided on their website descriptions of goods or services, price lists, 51.7% had links or references to their social media profiles, and 21% provided online ordering, reservation or booking. Regarding e-commerce, 5.7% of the enterprises received e-sales orders via computer network, and 4.4% of the enterprises received orders for products or services via Web- sales.

The Republic of North Macedonia has committed itself to approximation to the EU regulatory framework in the field of electronic communications. As a result of that commitment, the Law on Electronic Communications was adopted in 2005, which is fully harmonized with the EU regulatory package for electronic communications since 2002, and is legal framework for the full liberalization of the electronic communications market. Existing Law on Electronic Communications *("Official Gazette of the Republic of Macedonia" No. 13/2005; 14/2007; 55/2007; 98/2008; 83/2010; 13/2012; 59/2012; 123/2012; and 23/2013, 39/2014*) is fully aligned with the 2002 EU Electronic Communications Directives package. With a view to further development, the new legal framework should encourage and promote effective competition, investment and innovation, in particular with introducing next-generation broadband networks. The Law on Electronic Communications provides interconnection and access conditions by applying the principle of transparency and non - discrimination, the determination of operators with significant market power on a relevant market, universal provider selection service, introducing a procedure for notifying legal entities and individuals before start building public electronic communications networks and providing communication services, providing access to the services of another operator and more (*Law on Electronic Communications, 2005*).

The Agency for Electronic Communications was established by the Law on Electronic Communications (*"Official Gazette of the Republic of Macedonia" No. 13/2005, 14/2007 and 55/2007 and 98/8/2008 and 83/2010*) in 2005, as an independent regulatory body in the electronic communications markets. The Agency as a regulatory body is focused on the market, ensuring openness of public communication networks, the development and promotion of electronic communications networks and services, market analysis and the identification of operators with significant market power, tariff control, service price control, and more (*Law on Electronic Communications, 2005*). In order to regulate the electronic communications market in a systematic way, the Agency has well-defined goals to be achieved. The Agency has guidelines to achieve the goals of a competitive marketplace that will create the conditions for end-users to use the best quality and affordable electronic communication services.

On September 21, 2005, the National Assembly of the Republic of Macedonia adopted a National Strategy for Development of Electronic Communications with Information Technologies (Strategic Guidelines) prepared by the Ministry of Transport and Communications (*Ministry of Transport and Communications, 2005*). The need for adoption of this national strategy stems from the Law on Electronic Communications (*Official Gazette of the Republic of Macedonia No. 13/2005*), as well as from the basic generally accepted premises concerning the future development of the Republic of North Macedonia. This strategy represents the Republic of North Macedonia a top priority document with full implementation of projects, measures and the activities envisaged therein have a real opportunity to bridge the state the digital divide and in a short time make a significant jump in economic development, reducing unemployment and poverty, developing the digital economy, research and partnerships with industry (*Ministry of Transport and Communications, 2005*).

The National Strategy has a mission to include the economy of the Republic of North Macedonia in the world map of networked economies, creating the conditions for the leap in developing the economy (leap-frogging) through an aggressive introduction and massively efficient use of electronic communications and information technologies, which will enable the following 5 years to bring Macedonia closer to the average of the new EU member states, as measured all the more important indicators, both in terms of ICT and purely economic indicators.

Considering that the introduction of the information society in North Macedonia directly depends on the degree of supply-side development (development of communication infrastructures and technologies) and the degree of development of the demand-side (use of services and content), both strategies (National Strategy for the Development of Electronic Communications with Information Technologies and the National Strategy for Information Society Development), are a strong driver of a balanced economic process that will lead to the establishment of Information Society in the Republic of North Macedonia, as by demand as well as supply (mainly broadband understood as technological service, i.e. the basis for the realization of all advanced services). The degree of development on the supply side, i.e. the development of communication infrastructures directly depends on the process of liberalization and development of competition in the market electronic communications.

In terms of service utilization, the development of broadband networks plays a crucial role through policies that will stimulate demand for different types of services. These policies can provide financial incentives, improving government services through E-government, E-health, E-education, education of citizens, developing innovative public services, providing protection systems and trust, connecting public administration, schools, hospitals, small and medium enterprises, etc.

Commitment to create a proactive environment and environment to support the development of information society is also defined in the 2010 initiative of the European Union. The National Strategy for the Development of Electronic Communications with Information Technologies is based on the 2010 initiative of the European Union: creating a single information space with an open and competitive market offering access to electronic communications services and digital content, promoting the development of information and communication technologies as a driving force for the development of digital society, and the creation of an inclusive information society by bridging the digital divide (*Ministry of Information Society and Administration, 2010*).

Insights and experience on the prevalence of ICT technologies in institutions and companies in North Macedonia

The efficient, effective and professional functioning of the public administration in each country is one of the key factors for its democratic, political and economic development. The way the public sector performs its functions directly affects the quality of life of the different categories in society. The introduction of information and communication technologies is one of the key approaches in reforming public administration by using ICT tools to improve many different segments of its functioning (*Ministry of Information Society and Administration, 2010).*

While it is quite clear that ICT cannot solve all the problems in the functioning of public administration, it is a surprisingly long list in the areas in which their proper implementation can positively affect. The use of ICT in the public administration has enabled the improvement of the internal organization and efficiency of institutions, as well as the conditions for the secure storage and internal exchange of relevant data, the emergence of the Internet laid the foundations for the establishment of broad communication and direct access to each interested user to public institutions. In other words, the Internet opened the possibility to increase the availability of data through the websites of public institutions, as well as to open electronic communication channels through which users can access the data and services of public institutions at any time and from any place (*European Commission, 2014*).

Electronic communication in North Macedonia has been largely implemented and is still is in the process of modernization in the institutions and companies that exist to meet the needs of the citizens (consumers), like the Health Insurance Fund (HIF), Public Revenue Office (PRO), Central Register, banks and so on.

With the Health Insurance Fund web portal software solution project, HIFM is among the first institutions to start implementing e-services for its insureds. The digitalization of medicine is a vital for the development of the sector and the effective provision of medical services. Digital medicine ensures the interaction between patients, medical workers and institutions using information and communication and digital technologies. The following services are available:

-   For insurers - access to personal insurance and insurance data of its members, data on selected general practitioners, dentistry and gynecology for themselves and their members younger than 14 years.

-   For companies - an opportunity for electronic application for health insurance for persons for whom M1 application has been received from the Employment Agency of Macedonia, electronic application for their members and registration of members. The authorized person must have an electronic health card in order to use this service.

- For health care providers - opportunity to check insurance coverage for insured persons using health services.

- For selected GPs, gynecology and dentistry - the possibility of electronic change of a chosen doctor, follow up of records of insured persons with active reports, records of logs, etc. In this way, there is no need for companies and family doctors to come to the regional offices of the Health Insurance Fund.

In banking, the speed of digitalization is unprecedented. This implies revolutionary changes in information processing systems of banks, qualification requirements and financial services. There is a change in the banking system model, which makes it possible to reduce costs and increase the productivity of financial services. At the same time, digitalization in banking involves the accumulation of intangible capital, which is not always properly evaluated in the capital markets, thereby creating "bubbles", as well as significant problems related to confidentiality, regulation, control, supervision and the inability to ensure equal conditions for all participants of the banking market. With the development of information technology and its application in North Macedonia new trends in banking are introduced, new and improved services are offered and clients can freely choose the way they interact with the banks. Although North Macedonia cannot be compared to Western European countries in terms of the use of electronic financial services, in recent years there has been a great improvement in this regard, ie electronic banking is in continuous process of development.

The development of digital technologies in the Public Revenue Office (PRO) of the Republic of North Macedonia from 2011 onwards is perceived as reducing the flow of paper documents and in increased electronic business, enriching the database and increasing the level of transparency and accountability of each individual. An electronic archive means electronic recording, storage, and deployment of all incoming and outgoing documents and registration of their internal movement. Completion of the initial design of the electronic archive (document management), the design of the deployment and monitoring of the movement of documents in the PRO (document flow management), the introduction of an electronic signature for each employee and the creation of an electronic file for each subject and an electronic file for each taxpayer.

The system of electronic registration in the Central Registry offers a fast, simple and a reliable way of realizing all kinds of registrations in the Trade Registry of legal entities. In addition, when registering a legal entity, there is a possibility to register a legal representative in the obligatory social insurance fund (pension, disability, and health insurance).

Distance learning systems, e-learning, lifelong learning and other flexible forms of learning, as well as opportunities for developing and presenting multimedia and multilingual content, are just some examples of the place of information and communication technologies in the new e-education.

Considering E-democracy, digital technologies provide new opportunities to attract citizens to participate in social and political processes. Traditional democratic processes (offline) can be transferred into digital. The forms of the e-democracy development are e-parliament, e-voting, e-justice, e-mediation (pretrial settlement of disputes), e-referendum, e-consultations, e-petitions, electronic political campaigns and polls. But the most important area is electronic voting. This is the simplest form of e-democracy, but its implementation brings a number of political and organizational challenges. In addition, it is this form that is gradually being introduced in various countries, thereby forming international practice. Providing voters with electronic means of voting is a matter of optimizing electoral technologies. Voting via the Internet

facilitates access to the procedure for a significantly large number of citizens, increases the overall efficiency of obtaining voting results and makes it possible to vote remotely (New Digital Economy, 2011). The creation of an electronic voting program will attract a larger number of citizens, especially young people, improve the representation and quality of elections, as well as reduce possible falsification of results.

As the world tries to find effective solutions to the COVID-19 pandemic, governments and businesses are becoming increasingly reliant on digital technologies to support their communities and citizens. Like many others, the Macedonian Government implemented various strategies to prevent further spreading of the virus. Communities are also very active, and the number of digital initiatives grows daily. In North Macedonia, a total of 546 initiatives were submitted to the Fond for Innovation and Technology for handling the COVID-19 crisis, among which were also IT platforms and applications.

Aimed at taking measures to prevent virus transmission and to create conditions for faster eradication, a mobile app was developed as a complementary measure to the activities of the Ministry of Health of the Republic of North Macedonia. StopKorona! is a mobile app for tracing exposure with potentially infected persons, by the detection of the distance between mobile devices/applications, using Bluetooth technology. The underlying aim of the app is to provide a fast response to healthcare authorities about persons that have been in close contact with the infected person in the past 14 days. Data deriving from StopKorona! are integrated into the Ministry of Health process of tracing of potentially exposed persons to COVID-19, upon consent given by app users.

The community in North Macedonia, among which also the media, supported the efforts of the institutions to inform the citizens, through creating and sharing educational visualizations and videos, but also used these tools to raise awareness on the downside of the system, to combat misinformation related to the pandemics and to share information on successful community volunteer initiatives. In this time of crisis, where nations are forced to fight on multiple levels, we can witness the underlying importance of the Digital Agenda for Western Balkans and its role.

In many aspects, this pandemic has increased the need for electronic services across the country. Institutions, organizations, as well as citizens, are in the stage of dealing with many challenges, and while we can say that there are improvements in terms of the implementation of the Digital Agenda, it is evident that many of these solutions should be available long-term. The next steps should introduce a variety of digital tools in education, and above all, in the capacity building of the educators. The Government needs to work on better coordination of initiatives in a time of crises as well as on local self-governance.

RESULTS FROM THE RESEARCH

To gain a better picture of the usage of ICT in North Macedonia, as well as users satisfaction and perception of the degree of improvement of the effectiveness and efficiency of the companies and public institutions, "face-to-face", semi-structured, interviews were conducted with the citizens, the managers of the private sector companies using the electronic services, the employees, the heads of state institutions in the Republic of North Macedonia, such as the Public Revenue Office (PRO), Health Insurance Fund of North Macedonia, Central Registry, Banks, and others. We developed 3 types of Questionnaires: for the managers, for the employees and for the customers or users of services.

Forty respondents (managers in companies and institutions) using electronic communication tools participated in this study and were asked to evaluate the effectiveness of their company or institution with the use of electronic communications tools. They were asked to compare the level of satisfaction they have for three years (from 2016 to 2018). Their answers are systematized in Table 1.

Table 1: Level of satisfaction of the managers using electronic communications tools

Are you satisfied with improving the efficiency of your company's operations by using electronic communications tools?						
Year of Survey	Unsatisfied	Partly Satisfied	Satisfied	No Answer	Total	Average Rating
	%	%	%	%	%	
2016	21,4	21,2	51,3	6,1	100	3,58
2017	8	32	56	4	100	3,58
2018	7,38	33,76	57,2	1,66	100	4,21

From Table 1, we can conclude that from 2016 until 2018 the level of satisfaction is continuously increasing while the level of dissatisfaction is continuously decreasing, indicating that with the introduction of electronic communication in the companies and institutions efficiency is increased from an average rating 3,58 to 4,21.

Table 2: Level of satisfaction of the employees using electronic communication in the companies

Number	Question	n	Yes	No
			%	%
1.	Do you have experience using electronic communication in your institution?	40	65	35
2.	Has your company increased its efficiency by introducing and regularly using electronic communication in your company operations?	40	91	9
3.	Does your company regularly use electronic communication tools?	40	60	40
4.	Do you regularly communicate through electronic means of communication?		85	15
5.	Are you satisfied with the level of electronic communication in your company?	40	90	10
6.	Are you efficient in doing business using electronic communication devices?	40	82	12
7.	Do you find that your colleagues are effective in accomplishing their tasks using electronic communication?	40	78	22
8.	Do you think that working conditions improved at your company using electronic communication tools?	40	92	8
9.	Do you believe that better organization through electronic communication improves work efficiency?	40	94	6
10.	Do you feel a positive work atmosphere in your day-to-day work using electronic communication to perform your business activities?	40	95	5
11.	Do you think that increasing the efficiency of using electronic communication will increase customer satisfaction?	40	72	28

Table 2 shows the answers to questions that were an integral part of Questionnaire No. 2 that was conducted in 2019 from May to August. Questionnaire No. 2 was composed of 11 questions that were strictly related to the research topic. The respondents voluntarily filled in the questionnaire but due to the protection of personal data, their identity remained anonymous. The survey was conducted also by 40 respondents employed in institutions using electronic communication facilities.

Questionnaire No. 3 shows the level of satisfaction of the customers or users of the products and services of the companies and institutions (*Table 3*). The respondents (20) were citizens who were accidentally found in the institutions and participated in the survey voluntarily.

Table 3: Level of the satisfaction of the customers

Questionnaire 3 - Survey conducted with citizens		
	YES	**NO**
Are you satisfied with the work of institutions that use electronic communications and electronic services ?	88%	12%
Do you think that institutions are more efficient than before with the use of electronic communication?	92%	8%

The results obtained from the research indicate that the usage of electronic communication facilities in the institutions and companies in the Republic of North Macedonia efficiency, as well as the effectiveness, has been increased. Besides, the survey questionnaires provided results that showed increased satisfaction of the employees and citizens in the institutions with the use of electronic communication means.

CONCLUSIONS

Digital economy goes beyond e-commerce and e-business and includes doing business, conducting communications and providing services across all sectors including transport, financial services, manufacturing, education, healthcare, agriculture, retail, media, entertainment and business using digital technologies. Digital economy plays a significant role in accelerating global economic development, enhancing productivity of existing industries, cultivating new markets and industries, and achieving inclusive, sustainable growth. At the same time, the digital economy is becoming a powerful catalyst and a driver of inclusiveness, by linking communities to each other in a sort of "global village", sharing information, ideas and products, and allowing countries to rise up the value chain.

The unprecedented global health crisis has transformed the macro landscape of economic activities worldwide. "Going digital" has become one of the remedies for economies and a "survival strategy" for businesses since the outbreak, as offline activities are almost shut down. The Covid-19 pandemic continues to impact people's lives, families, communities and the global economy and its evolution remains uncertain. So, in a few years, it is possible that no one will be speaking of "digital transformation" because the term will have become irrelevant: Non-digital businesses will simply not exist. To avoid becoming one of those dying businesses, organizations must embrace digital transformation now. Digital technology offers this potential: new ways to create new value for all stakeholders, while making business models more inclusive, sustainable and trustworthy. Addressing the long-term impact of the COVID-19 crisis requires redirecting the focus of international cooperation to the implementation of digital transformation and application of digital services. Particular consideration should be given to most vulnerable societies to avoid a further widening of the digital divides.

The use of the digital technologies in the past period in the Republic of North Macedonia has experienced a special expansion in retail, financial services, education, health and so on. Generally speaking, the advantage of electronic over traditional communication is related to increased quality, agility in offering and providing additional services on the one hand and reducing costs and time in conducting transactions on the other.

The advantages of using digital technologies are: better delivery of government services through fully coordinated and integrated public administration activities, improved interaction with the business sector

and industry, quality and rapid response to civil needs and demands, citizen participation in building an information society, efficient government management, increased number of ICT experts and increased level of ICT literacy in public administration, open, participatory and democratic government, reduced corruption, increased transparency, increased revenues and reduced costs, new forms of evaluation and improvement of the public administration and the creation of value for society in general.

Citizens of the Republic of North Macedonia have open access to government information and services and will have the opportunity to participate in building a democratic society in North Macedonia through the use of the Internet, telephony and other technologies, face reduced corruption, greater transparency and increased information security in practicing their rights and obligations. Web processes should make life easier and more comfortable for citizens: they do not have to be physically present to use the services, they do not have to wait in line, there is no working time, no waste of time walking from one institution to another, there are only simple processes and forms that are logically designed.

The business sector in the Republic of North Macedonia has broader and more open access to information, a better business climate, economic vitality, and will face greater transparency, reduced corruption, greater accountability and trust to the state administration in exercising its rights and obligations. In the same way cooperation between institutions that use digital technologies has been improved. It can be concluded that the development and application of e-technologies is one of the strategic priorities of the state and that their implementation is a structured and planned process that improves the functioning of the public and business sector.

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CHALLENGES OF DIGITAL TRANSFORMATION OF GOVERNMENT IN BOSNIA AND HERZEGOVINA - NECESSITY OF ADMINISTRATIVE PROCEDURE REFORM

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Abstract

The fourth industrial revolution, the emergence and development of which we are witnessing, is definitely changing the ways of our lives, work and mutual relations. It is characterized by a comprehensive integration of technologies that blurs the boundaries between the physical and digital world. This represents a complete transformation of societies, not just the introduction of new technologies. It is necessary for the whole society, including the public administration, to transform in order to keep up with the rest of the world. Unfortunately, the public sector, and especially the public administration, often does not react promptly. Their belated, often forced reaction, inflicts significant damage on society as a whole. The COVID-19 pandemic has forced society as a whole, including the public sector and public administration, to make some progress in the faster and more intensive introduction of e-Government, as one of the segments of the digital transformation in government. In this article, the authors deal with the challenges in establishing an appropriate legal framework in Bosnia and Herzegovina, which enables the establishment of e-Government i.e. the use of information and communication technologies in the activities of public administration. Due to the specific constitutional order of Bosnia and Herzegovina, regulations regarding the of e-Government have been adopted at different levels of government, but still have many similar elements. One of the risks in the process of introducing e-Government may be different standardization in the field of administrative procedures. The authors analyze the challenges facing Bosnia and Herzegovina in terms of establishing a legal framework for the use of information and communication technology in administrative proceedings, as well as the challenges facing society in terms of administrative procedure reforms and the introduction of e-procedures in general.

Keywords: Digital transformation, e-Government, information and communication technologies, reform of the public administration in Bosnia and Herzegovina

INTRODUCTION

The transition of former socialist states from a socialist system and a planned, state-controlled economy to democratic political systems with an open market economy has been a long and complex process. Efforts to make progress that is more significant have been hampered primarily by the fact that instead of collapsed previous value system, there has been no timely change in political and administrative culture[4],

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creating a kind of value vacuum[5]. A particularly aggravating factor in the implementation of the transition was that precisely those forces that were supposed to encourage social change (political power and administration) were themselves the subject of reforms[6]. As the results of the transition we can identify more or less successful democratization of states and a successful transition to a market economy[7]. However, this transitional path of each of the countries is (was) specific, and each of them, in addition to many similarities, faced its own special challenges along the way[8].

The challenges of all transitions are that they are not static, but very dynamic categories. Transition is a kind of "moving target", as the goals of transition countries tend to change "on the fly". One of the significant changes is the digital transformation, as one of the forms of adaptation to the Fourth Industrial Revolution. According to Schwab, the Fourth Industrial Revolution is *„technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society"[9]*. The introduction and use of digital technologies is transforming societies, economies, institutions and companies around the planet, but that is not enough to be able to talk about digital transformation. Reductionist approaches limit digital transformation only to certain areas of human work and action, e.g. business[10]. However, digital transformation is a more comprehensive and broader concept, which, in addition to the introduction of digital technologies, requires a re-examination of existing organizational structures, work processes, skills, culture and ways of thinking[11]. Thus, we can state that the digital transformation represents a significant change in the basic way of working, acting and creating value both in society as a whole and in its individual parts[12].

Based on the analysis of numerous definitions of the term "digital transformation", three important aspects can be noticed: organizational, technological and social. Organizational aspect of digital transformation includes the improvement and change of existing processes and their transformation into "smart processes". Technological aspect implies the introduction of technological inventions and innovations, which will enable significant improvements in quality, efficiency and revenue. Social aspect

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[6] I. Koprić et al., (2014), *op. cit.*, p. 39.

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encompasses networking, new methods and channels of communication, but also creating a different mental structure and expectations of citizens[13].

In the context of Bosnia and Herzegovina as a country in transition, the issue of digital transformation can still (and must) be viewed through the prism of transition. In this sense, as the relationship between political power and public administration can be defined as one of the fundamental issues of transition, public administration reform is inevitably imposed (and) as a significant transitional issue. Moreover, successful reform of public administration, oriented towards citizens, is not possible without the modernization of administrative procedures.

STRATEGIC FRAMEWORK OF PUBLIC ADMINISTRATION REFORM IN BOSNIA AND HERZEGOVINA

In the context of Bosnia and Herzegovina, as a very complex state, the first Public Administration Reform Strategy[14] (hereinafter referred to as "the Strategy") was adopted in 2006, announcing major changes in the philosophy and manner of work and conduct of public administration. The strategy was synchronously adopted by the state[15], entity[16], and the Government of the Brčko District of Bosnia and Herzegovina[17], and it was implemented through action plans[18]. After the expiration of the deadlines set by the action plans, in 2015, each of the above governments adopted conclusions supporting the continuation of public administration reform *"through the continuation of initiated but unrealized projects and other activities envisaged by the Public Administration Reform Strategy and RAP1"*[19]. Recognizing that public administration reform is a prerequisite for the successful integration of Bosnia and Herzegovina into the European Union, as well as obligations under the Stabilization and Association Agreement[20], all governments in Bosnia and Herzegovina have supported the development of a Strategic Framework for Public Administration Reform in Bosnia and Herzegovina. 2018-2022 year (hereinafter referred to as "the Strategic Framework"). With the support of a number of international actors[21], the Strategic Framework has been

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[18] Action plan 1 - AP1 (2006.-2010.) and Revised Action plan 1 - RAP1 (2011.-2014.).

[19] Information on activities in the process of public administration reform, adopted by the Council of Ministers of Bosnia and Herzegovina: Decision no. 05-07-1-1724-15/15 on 10.07.2015., Government of Federation of Bosnia and Herzegovina: Decision no. 865/2015 on 09.07.2015., Government of Republic of Srpska: Conclusion no. 04/1-012-2-2523/15 on 05.11.2015. and Government of Brčko Disctrict of Bosnia and Herzegovina: Act no. 01.11-1031DS-02/15 on 05.06.2015.

[20] Stabilization and Association Agreement between the European Communities and their Member States, of the one part, and Bosnia and Herzegovina, of the other part, signed in Luxembourg on 26 June 2008. ratified by the decision of the Presidency of BiH on November 6, 2008. ("Official Gazette of Bosnia and Herzegovina" - International Agreements, No. 10/08), and entered into force on 01.06.2015.

[21] e.g. Embassy of the United Kingdom in BiH through the Good Governance Fund (GGF Fund); German Society for International Cooperation (GIZ) through the Program for Strengthening of Public Institutions (SPI Program); The EU Delegation to BiH, SIGMA, as well as other donors to the Public Administration Reform Fund

developed but has not yet been adopted at all levels of government[22], making it (still) inapplicable throughout the whole territory of Bosnia and Herzegovina.

The vision and key goal of public administration reform is to develop a more efficient, effective and accountable public administration that *"would provide citizens with better services for less money, operate on the basis of transparent and open procedures fulfilling all the conditions set for European integration, and thus would truly become a mean for continuous and sustainable socio-economic development"*[23]. In order to meet the set goals, five key reform areas have been identified, among which, as a separate one, the area of administrative procedure is mentioned. The strategy emphasizes that the administrative procedure is *"a key component of the interaction between government and citizens"* and that its reform is *"the central basis for ensuring the efficiency, effectiveness and predictability of public administration in providing public services to society"*. The focus of the reform in this area is on improving the quality of administrative decision-making, including simplification and improvement of administrative procedure, in accordance with modern European standards of administrative decision-making[24].

The reform was initially approached very optimistically, however, its implementation was not followed by initial enthusiasm[25], since a full decade after the deadlines set by the Strategy (2017), SIGMA[26] states in its Monitoring Report[27] that in Bosnia and Herzegovina *"...Service delivery and administrative behaviour are inconsistent due to the parallel legal frameworks for administrative procedures. Different Laws on General Administrative Procedures (LGAPs) are being implemented at the levels of the State, both Entities and the BD. The LGAPs provide general safeguards against maladministration, but they lack strong provisions on electronic communication and on the "once only" provision of information"*[28].

THE NEED TO INTRODUCE INFORMATION AND COMMUNICATION TECHNOLOGIES IN ADMINISTRATIVE PROCEDURES

Increasing the amount of information and available knowledge in society, and especially the development of information and communication technologies, is one of the most important factors that contributes to

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[22] The strategic framework was adopted by the Council of Ministers of Bosnia and Herzegovina, Decision no. VM-211/18 on 25.09.2018.

[23] Public Administration Reform Strategy in Bosnia and Herzegovina, *op. cit.*

[24] Među evropskim standardima upravnog odlučivanja naglašavaju se: uključivanje minimuma procesnih zahtjeva primjenjivih u praksi u zakone o upravnom postupku; osiguranje jače uloge drugostepenih organa u ocjenjivanju činjenica prilikom odlučivanja o zahtjevu stranke; uvođenje elektronske komunikacije između organa uprave i stranaka; povećanje pritiska na organe uprave da što brže donose odluke, što bi trebalo smanjiti broj slučajeva „šutnje uprave"; ukidanje ili prilagodbu sistema vanrednih pravnih lijekova i usklađivanje legislative sa standardima u zemljama EU te za smanjenje upotrebe posebnih upravnih postupaka u materijalnim zakonima.

[25] Among the European standards of administrative decision-making are: the inclusion of the minimum procedural requirements applicable in practice in the laws on administrative procedure, ensuring a stronger role of second instance bodies in assessing the facts when deciding on a party's request, introduction of electronic communication between administrative bodies and parties, increasing pressure on administrative bodies to make decisions as quickly as possible, which should reduce the number of cases of "administrative silence", abolition or adaptation of the system of extraordinary legal remedies and harmonization of legislation with standards in EU countries and reduce the use of special administrative procedures in substantive laws.

[26] *SIGMA (Support for Improvement in Governance and Management) is a joint initiative of the European Union and the Organization for Economic Co-operation and Development (OECD) aimed at supporting the reform of the governance of countries in the process of joining the European Union.*

[27] SIGMA, Monitoring Report: Principles of Public Administration, Bosnia and Herzegovina, 2017. p. 119

[28] *Ibid.*

changing the social environment in which we live and work.[29]. Mass use of information and communication technologies has introduced significant changes in all spheres of life, including business areas, but also administration[30]. Introduction of information and communication technologies is one of the important means for improving the efficiency, but also the democratic content of public administration[31]. The use of information and communication technologies in public administration significantly improves existing working methods and greatly contributes to increasing its efficiency and productivity. If the public administration wants to fulfill its role of socially useful and necessary service in the function of social progress, it must adapt to the new situation[32].

At least declaratively, all levels of government in Bosnia and Herzegovina agree that successful public administration reform is not possible without reform and modernization of administrative procedure, and that administrative procedure reform cannot be discussed if its implementation does not enable the application of modern information and communication technologies[33]. In this context, the Strategic Framework emphasizes the introduction of e-government, while respecting the principle of *"everything in one place"*. The transformation of public administration in the direction of intensive and wide application of information and communication technologies has been highlighted as one of the key segments of the process of building the information society. Such a transformation would provide citizens, business partners, non-governmental and other institutions with permanent access to its services as well as with simple, efficient and cheap business operation[34]. The use of information and communication technology in the relationship between administrative bodies and citizens and legal entities is one of the important factors in the modernization of public administration and should become a common way of communication between these entities. To meet this goal, it is necessary to meet certain prerequisites, firstly, the establishment of an appropriate legal framework which would regulate the use of information and communication technology in administrative procedures and, secondly, the development and implementation of specific technological solutions in the field of information and communication technology, both on the side of public administration and on the side of users[35]. The application of information and communication technology in society affects the change of a number of classical legal institutes, such as e.g. handwritten signature in electronic signature.

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[29] Ljubanović, D. (2009), „Izazovi upotrebe sredstava elektroničke komunikacije i novi zakon o općem upravnom postupku", „Modernizacija općeg upravnog postupka i javne uprave u Hrvatskoj", Institut za javnu upravu i Društveno veleučilište u Zagrebu, Zagreb, p. 123.

[30] Radovanović, S. M., Miščević, N. B. (2018), „O elektronskoj formi ugovora u domaćem pravu", Zbornik radova Pravnog fakulteta u Novom Sadu, god. LII, br. 4, p. 1642.

[31] Golić, D. P. and Matijašević - Obradović, J. D. (2014), „Informacione tehnologije kao sredstvo demokratizacije javne uprave", Singidunum Journal of Applied Sciences, p. 105.

[32] Ljubanović, D., *op. cit.*, p. 123.

[33] According to definition *„Information and Communication Technologies consist of hardware, software, networks, and media for colletion, storage, processing, transmission, and presentation of information (voice, data, text, images),* Information and communication technologies: A World Bank Group Strategy (2002) at http://documents1.worldbank.org/curated/en/421471468325303463/pdf/800880PUB0Info00Box379796B00PUBLIC0.pdf (last visited: 13.07.2020.).

[34] Strategy of Information Society Development of Bosnia and Herzegovina, at: https://wbc-rti.info/object/document/7887/attach/1388_Strategy_for_IS_development_in_BH.pdf, (last visited: 13.07.2020.) p. 76

[35] Staničić F., Jurić M. (2015), „Pravni okvir za implementaciju informacijsko-komunikacijskih tehnologija u hrvatsko upravno postupovno pravo", Zbornik Pravnog fakulteta u Zagrebu, vol. 65, br. 5, p. 635-663.

SIGNIFICANCE AND CONCEPT OF E-GOVERNMENT

Digitalization, which has affected almost all segments of society in the last few decades, also takes its place when it comes to the functioning of administrative bodies and the public sector in general. The digital (fourth industrial) revolution has a deeper intensity and greater effects on society and the economy compared to all previous revolutions, so that a possible lag in it can make some countries backward.

Increased use of information and communication technology by public authorities dramatically affects the provision of public services through websites and portals, smartphones, social networks, which is reflected in the increased number of users and reduced costs for governments that decide to introduce their use. Information and communication technologies also enable the delivery of public services to be targeted, personalized and on time, which gives the user much more advantages than traditional service delivery, in terms of access, convenience through availability 24 hours a day, saving time, and travel costs instead of going to offices[36]. The Internet and modern technologies have great potential for reforming the traditional view of government as a hierarchically organized "instrument of state influence on society" into a modern service for citizens and the economy, which focuses on user needs and whose legitimacy is measured not only by legality, but also by efficiency and quality of services delivered[37]. Although the services provided by the public sector are numerous and very diverse, all of them can be classified under the term e-Government in the broadest sense, and the possibilities provided by digitalization, i.e. the introduction of e-Government are numerous.

Governments and public sector organizations, which tend to show long processing times, lack of flexibility, and a focus on processes instead of results, currently face many challenges, especially general demands of reducing costs and improve operations. The upcoming digital native generation demands better public service provision in terms of convenient access and interaction as well as ongoing personalization and customization possibilities. To handle with these requests and relieve growing pressures, they need to move away from traditional bureaucracy as soon as possible and move on to doing business that centers on the client: citizens as well as governmental and non-governmental organizations[38]. However, the key benefit of such processes is the strengthening of the basic principles on which the constitutional order of a state is based, such as the principle of the rule of law, then the principles of proportionality, efficiency, transparency, acting within a reasonable time, etc. which significantly improves the functioning of public administration as a whole.

This concept implies, in the broadest sense, the use of information and communication technology by public authorities in performing their tasks. In functional terms, e-Government is focused on three spheres: (1) towards citizens, (2) towards legal entities and companies, and (3) mutual interaction between public bodies themselves[39]. Definitions of the term e-Government are numerous and different[40], and they

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[36] United Nations Department of Economic and Social Affairs (2018), *United Nations E-Government Survey 2018 – Gearing E-Government to support transformation towards sustainable and resilient societies*, New York, p. 17. at: https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2018-Survey/E-Government%20Survey%202018_FINAL%20for%20web.pdf (last visited: 13.07.2020.)

[37] Dimitrijević P. (2009) Umrežena javna uprava. Pravni život, Beograd, no. 11/2009, p. 113-117.

[38] Writz B., Daiser P. (2015) *E-Government - Strategy Process Instruments,* German University of Administrative Sciences, Speyer, p. 4.

[39] Dimitrijević P. (2009), „Elektronska uprava i informaciono društvo", Moderna uprava, no. 2/2009, Banja Luka, p. 127.

[40] See: B. Writz and P. Daiser, p. 8.

differ in the scope they cover, the entities to which they refer, as well as the technologies they use[41]. According to B. Writz and P. Daiser *the term e-government describes the electronic handling of administration and democracy processes in the context of governmental activities by means of information and communication technologies to support public duties efficiently and effectively*[42]. All this indicates that e-Government cannot be reduced to a mere computerization of the process led by public authorities, but that it is a complex process based on institutional change aimed at the ability of public institutions to adapt to new technologies, conditions and needs through greater efficiency, efficiency, transparency, accountability and inclusiveness[43].

The process of introducing e-Government in Bosnia and Herzegovina

The introduction of e-Government in Bosnia and Herzegovina is a special challenge. The complex state system and the non-hierarchical system of government, in the relationship between the state and the entities, as well as in one of its entities (Federation of Bosnia and Herzegovina), significantly complicate the situation. Public services to citizens are provided by public administration in 141 municipalities, ten cantons, two entities, Brčko District and at the state level. Taking into account the above, the question arises whether, in these circumstances, it is even possible to establish an efficient e-Government?

Bosnia and Herzegovina in 2002 showed its commitment to the introduction of information and communication technology in the field of administration, when, by accepting the eSEE Agenda for the Development of the Information Society[44], committed to the adoption and implementation of the legal infrastructure for the information society, which included the adoption of laws on electronic commerce, electronic contracts and electronic signatures, in accordance with the framework of relevant directives of the European Union. Since these obligations have not been realized, in 2004, with the support of the United Nations Development Program (UNDP), a project called *"Strategy of Information Society Development of Bosnia and Herzegovina"* was launched, and within it, the *"Information Society Development Policy in Bosnia and Herzegovina"* was drafted. This document was an ambitious plan of reforms that would include, among other things, reengineering of the administration, i.e. transformation of the administration based on the application of information and communication technology, i.e. e-government, which would ensure the approximation of the administration and public services to the needs of citizens, business systems and non-governmental organizations and increase efficiency and quality of administration services while reducing costs. The goal was also to base the entire concept of development and implementation of e-Government on modern technological trends and technologies, establish a modern communication infrastructure, establish a technical framework for interoperability, harmonize, connect and integrate fundamental public data, ensure a secure environment for e-business administration, standardize software solutions and equipment, etc. In this way, the administration would make its work more transparent, and become closer to the citizens, who would become participants in governance in local and state structures[45].

The document lists a large number of activities whose implementation depended on the political will, technical capacity, available staff, which were often not available at the time, and the problem was the financial resources for their implementation. Short deadlines have been set for the implementation of the strategy, with high estimated costs. A significant part of these funds was to be provided by the entity

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[41] *Ibid,* str. 9.
[42] *Ibid,* str. 10.
[43] United Nations Department of Economic and Social Affairs (2018), *op. cit.,* p. 14.
[44] At: http://www.mkt.gov.ba/dokumenti/informatizacija/ostali_propisi/default.aspx?id=3547&langTag=bs-BA (last visited: 13.07.2020)
[45] See: Politika razvoja informacionog društva u Bosni i Hercegovini (2004), Vijeće ministara BiH, Sarajevo, p. 16-17.

governments, which, on the other hand, did not accept such an ambitious action plan[46], leaving it a dead letter on paper until the year 2017 when the Council of Ministers of Bosnia and Herzegovina adopted Decision[47] on Policy. In the meantime, certain steps have been taken and governments at all levels of government have been engaged in processes aimed at introducing e-Government, albeit to a limited extent. Laws on electronic signatures have been adopted at the level of Bosnia and Herzegovina[48] and Republic of Srpska[49], laws on electronic documents at the level of Bosnia and Herzegovina[50], Federation of Bosnia and Herzegovina[51] and Republic of Srpska[52] and, Law on Electronic Legal and Business Transactions at the level of Bosnia and Herzegovina[53]. Among the cantons, the Sarajevo Canton stands out, adopting the Framework Plan for the Development of e-Government[54], but even today, more than seven years after its adoption, no significant steps have yet been taken regarding its implementation.

Current situation and future challenges in the field of e-Government

The Strategic Framework is a document that removes a key obstacle to the further development of e-Government. Namely, the Strategic Framework, with its action plans, contains a cross-section of the situation, i.e. what and to what extent different levels of government have done to establish electronic services. In the area of e-Government, it envisages short- and medium-term reforms in six reform pillars: 1) Strategic planning, capacities for policy making and coordination; 2) Public finances; 3) Human resource management; 4) Administrative procedure and administrative services; 5) Institutional communication and 6) Information technology/e-Government. According to the data from the last semi-annual progress report prepared by the Public Administration Reform Coordinator's Office in Bosnia and Herzegovina (PARCO), which refers to the period January-June 2018, the realization of the goals from the sixth pillar (e-Government) is on at the lowest level, with a realization of 75%, with the Republic of Srpska achieving the largest number of goals, while in second place is the FBiH, which, despite the most complex constitutional structure, left behind the Brčko District and the state level of government[55].

The Strategic Framework also states that the potential for e-Government in Bosnia and Herzegovina is relatively satisfactory with more than two thirds of citizens having access to the Internet. This data in itself, however, does not have to mean much, given that it is very difficult to reliably assess the level of training and willingness of citizens to use e-Services.

The system of a single administrative place (One-stop shop), virtual or physical, is a clear and obvious choice of governments that intend to build a culture of services in public administration and that are user-oriented. There are several One-stop shop solutions at certain administrative levels in Bosnia and

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[46] Delić A. (2017), „Preduslovi reforme upravnog postupka u kontekstu praksi i standarda e-Uprave", Uprava, no. 16, Sarajevo, p 74.
[47] „Official Gazzete of Bosnia and Herzegovina", no. 42/17.
[48] „Official Gazette of Bosnia and Herzegovina", no. 91/06.
[49] „Official Gazette of Republic of Srpska", no. 106/15; This is a new law, the enactment of which repealed the Law on Electronic Signature of the Republika Srpska („Official Gazette of Republic of Srpska", no. 59/08 and 68/13).
[50] „Official Gazette of Bosnia and Herzegovina", no. 58/14.
[51] „Official Gazette of Federation of Bosnia and Herzegovina", no. 55/13.
[52] „Official Gazette of Republic of Srpska", no. 106/15.
[53] „Official Gazette of Bosnia and Herzegovina", no. 88/07.
[54] The Framework Plan for the Development of e-Government was adopted by the Government of Sarajevo Canton at its 3rd session held on 13.12.2012, at: https://vlada.ks.gov.ba/sites/vlada.ks.gov.ba/files/okvirni_plan.pdf (last visited: 13.07.2020.)
[55] Biannual progress report for 2018, Monitoring of the Revised Action Plan 1 of the Public Administration Reform Strategy in Bosnia and Herzegovina, for 2018, p. 14, at: http://parco.gov.ba/wp-content/uploads/2018/11/Polugodisnji-izvjestaj-o-napretku-2018.pdf (last visited: 13.07.2020.)

Herzegovina, which mainly relate to certain priority services, such as issuing residence permits, ID cards, passports and driver's licenses, registration of business entities, payment of contributions to tax administrations, etc. Electronic catalog of available services, as the initial basis for the establishment of virtual one-stop systems, exists at the level of Bosnia and Herzegovina and Republic of Srpska, but without the possibility of performing transactions[56].

One of the key steps on the way to the introduction of e-Government made by the Council of Ministers of Bosnia and Herzegovina is the adoption of the Interoperability Framework of Bosnia and Herzegovina, in 2018[57]. In addition, the Draft Law on Electronic Identification and Trust Services for Electronic Transactions was drafted, which is harmonized with the Regulation of the European Union No. 910/2014[58], and the implementation of the project *"Implementation of common services for eServices"* was completed.

In the Federation of Bosnia and Herzegovina, the House of Representatives has adopted the Draft Law on Electronic Signature, and it is necessary for this law to be adopted by the House of Peoples. The General Secretariat of the Federation of Bosnia and Herzegovina Government initiated activities aimed at forming a cloud of the Government, whose goal is to rationalize and optimize available hardware resources (using virtualization), as well as standardize the system, while the Government also adopted a Decision on establishing a web portal e-Government[59].

The project "Upgrading and establishing the system of e-Sessions of governments", which created the system of e-Sessions of the Republic of Srpska Government, established a system that meets the needs of the business process organized in connection with government sessions. The new Rulebook on systematization in the Republic of Srpska General Secretariat was also adopted by Government, where the Strategic Planning Department was formed, which partly took over the activities related to strategic planning and policy development.

Recent activities carried out in the Brčko District of Bosnia and Herzegovina relate to the expansion of PARCO's competencies within which a new organizational unit has been established to coordinate and assist the development of e-Government, whose task is to take care of interoperable information system and interoperability issues. Within the project "Implementation of joint services for eServices" a pilot service related to the implementation of the competition procedure for employment was realized, and the launch of the portal for eServices related to life events is also expected[60].

Regardless of the importance of the Decision on the adoption of the Strategic Framework for Public Administration Reform in Bosnia and Herzegovina 2018-2022, which clearly shows the plan of activities and priorities that need to be implemented in the coming period, there are still many risks and challenges that must be overcome during its implementation. First of all, it is an opportunity for the activities of all levels of government to take place in particular and without coordination, with the absence of strategic direction at the level of the Bosnia and Herzegovina. In this way, a certain level of government could be focused on one solution, while another would be focused on another, which would create inconsistencies

[56] Decision on Adoption of the Strategic Framework for Public Administration Reform in Bosnia and Herzegovina 2018-2022, (Official Gazette of Bosnia and Herzegovina, no. 85/18).
[57] Official Gazette of Bosnia and Herzegovina, no. 53/18
[58] Official Journal of the European Union, L 257/73
[59] Official Gazette of Federation of Bosnia and Herzegovina, no. 29/18.
[60] Biannual progress report for 2018, *op. cit.*, p. 51-56.

and lead to the fact that, despite the implementation of certain reforms, due to different solutions adopted, the system remains dysfunctional. In order to avoid such a scenario, it is necessary to have political will, engagement of all levels of government, especially PARCO, in order to ensure efficient and consistent implementation of activities aimed at establishing a functional e-Government system in the whole of Bosnia and Herzegovina.

Application of existing regulations in the field of e-Government

Although the Law on Electronic Signature at the level of Bosnia and Herzegovina was adopted in 2006, only recently have preconditions been created for its full implementation. Three years after the adoption of the Law, the Council of Ministers of Bosnia and Herzegovina adopted a Decision on the basics of the use of electronic signatures and the provision of certification services[61], but repealed it eight years later[62]. The Office for Supervision and Accreditation of Verifiers which, in accordance with the Law, supervises its implementation, was established in 2015[63], but the Rulebook on the Records of verifiers[64], Rulebook on the measures and procedures for the use and protection of electronic signature, electronic signature formation devices and the certification systems[65] and Rulebook on detailed conditions for issuing qualified certificates were adopted in 2017[66]. However, the application of the Law has not yet come to life, given that in October 2019, the selection of an accredited certifier of qualified certificates was made, which created the conditions for the application of electronic signatures in practice.

Republic of Srpska adopted the Law on Electronic Signature in 2015, and it entered into force on December 31, 2015. This law repealed the previous Law on Electronic Signature from 2008. In addition to the Law, the following rulebooks have been adopted to enable its implementation: Rulebook on special conditions that must be met by certification bodies[67], Rulebook on the records of certified bodies[68], Rulebook on technical-technological procedures for the production of qualified electronic signature and other trust services and measures for the protection of electronic signature and other trust services[69], Rulebook on the procedure for issuing permit and registration in the register of certified bodies for issuing qualified electronic certificates [70] i Rulebook on issuing a time stamp[71]. Analyzing the content of the state and entity law, it can be concluded that the law adopted at the entity level is much more precise and comprehensive. The general provisions of the state law are very poor, so Article 1 states only that this law regulates the basis for the formation and use of electronic signatures and the provision of services related to electronic signatures and authentication, while Article 2 states that its provisions apply in closed systems, which are fully regulated by contracts between a known number of contracting parties, if their application is contracted, and in open electronic communication with the court and other institutions,

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[61] Official Gazzette of Bosnia and Herzegovina, no. 21/09.
[62] Decision on repealing the Decision on the basics of the use of electronic signatures and the provision of certification services (Official Gazzette of Bosnia and Herzegovina, no. 53/17).
[63] See: http://www.mkt.gov.ba/sektori/ured_za_nadzor/default.aspx?id=6313&langTag=bs-BA&template_id= 100&pageIndex=1. (last visited: 13.07.2020.)
[64] Official Gazzette of Bosnia and Herzegovina, no. 14/17.
[65] *Ibid.*
[66] *Ibid.*
[67] Official Gazzette of Republic of Srpska, no. 78/16.
[68] *Ibid.*
[69] *Ibid.*
[70] *Ibid.*
[71] Official Gazzette of Republic of Srpska, no. 112/16.

unless otherwise provided by a special law[72]. On the other hand, the Law on Electronic Signature of the Republic of Srpska is much clearer and more detailed in terms of what its subject is, in which territory it is applied and who its subjects are, so its Article 1 states that it regulates the rights of natural and legal persons. on the use of electronic signature in administrative, judicial and other proceedings, business and other activities, and the rights, obligations and responsibilities of natural and legal persons who provide services for creating, verifying and validating electronic signatures, time stamps, electronic seals and certificates for authentication of web pages territory of RS, unless otherwise provided by a special law. From the above, it is clear that the law distinguishes between natural and legal persons who have the right to use electronic signatures, and natural and legal persons who provide services for its creation, verification and validation[73].

In the texts of the law itself, it is possible to notice certain terminological differences, as well as differences in terms of definitions of terms. In this regard, state law distinguishes between electronic signature and secure electronic signature, while entity law distinguishes between electronic and qualified electronic signature. However, if we analyze the provisions that contain the definition of these terms, it is clear that their meaning is essentially the same. Both signatures replace the handwritten signature, they are connected exclusively with the signatory, their goal is to identify the user, etc. State law distinguishes between general and special legal action and prescribes for what purposes an electronic signature may be used, and when its legal action and its use as evidence cannot be excluded. Similar provisions are contained in the entity law, and terminological differences reappear, where the state law contains provisions on qualified certification, while the entity law contains provisions on qualified electronic certificate, although again these are essentially the same documents. Both laws prescribe a similar procedure when it comes to the registration of certifiers, i.e. certification bodies that issue a certificate. According to the definition from Article 3 of the State Law, a certifier is a natural or legal person that issues certificates or time stamps or performs other services related to electronic signature and certification, and in order to issue qualified certificates, it must be accredited by the Institute for accreditation of Bosnia and Herzegovina, upon submission of the application. The supervisory body is the Office for Supervision and Accreditation of Certifiers at the Ministry of Transport and Communications of Bosnia and Herzegovina, which maintains an electronic register of certifiers based in Bosnia and Herzegovina, accredited certifiers and certifiers based in third countries whose certificates are guaranteed by a certifier based in Bosnia and Herzegovina. On the other hand, the Ministry of Scientific and Technological Development, Higher Education and Information Society of Republic of Srpska issues a license to a certification body at its request and enters it in the Register of Certification Bodies in RS, if that body wishes to issue qualified electronic certificates. Supervision over the application of this Law and the work of certification bodies is performed by the Republic Administration for Inspection Affairs of Republic of Srpska through competent inspectors.

The main problem that could arise in the application of these laws is that institutions of different levels of government do not mutually recognize signatures certified by authorized natural or legal persons from another level of government. A much simpler solution would be to have a single register of certifiers, ie certification bodies at the state level, which would be applied on the entire territory of Bosnia and Herzegovina. However, there is no political agreement for this type of establishment of the functioning of the system, and the problems do not currently exist solely because the conditions for its full implementation were created recently, in October 2019.

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[72] Official Gazzette of Bosnia and Herzegovina, no. 91/06.
[73] Official Gazzette of Republic of Srpska, no. 106/15

Laws on electronic document have been adopted at both the state and entity levels[74]. All three laws have a very similar structure and content, and their goal is to regulate the use of electronic document in the actions and activities of competent authorities and natural and legal persons, as well as proceedings before competent authorities in which electronic equipment and programs can be used in drafting , transmission, reception and storage of information in electronic form, legal validity of the electronic document, and use and circulation of the electronic document. The provisions of the laws relating to the electronic document and its use and circulation are almost identical. Differences occur in the provisions relating to law enforcement supervision authorities, as expected. The Inspectorate of the Ministry of Communications and Transport of Bosnia and Herzegovina is supervisory body at the level of Bosnia and Herzegovina, the Federal Ministry of Justice at the level of FBiH and the Republic of Directorate for Inspection Affairs at the level of Republic of Srpska. Differences also occur in the provisions concerning penal provisions, as well as in the transitional and final provisions. Unlike the entity laws, which entered into force on the eighth day after publication in the Official Gazette of Federation of Bosnia and Herzegovina, i.e. the Official Gazette of Republic of Srpska, the state law also entered into force on the eighth day after publication, but its application was conditioned by the establishment of the Office for supervision and accreditation of certifiers established by the Law on Electronic Signature[75]. Although these laws are formally and legally in force and applied, their full implementation will wait for some time, because their implementation requires, in addition to information and communication training, both authorities and parties, significant financial resources to establish information and communication infrastructure. It is very difficult to say at the moment when that will happen, especially at the state level.

THE CURRENT SITUATION IN THE FIELD OF ADMINISTRATIVE PROCEDURES

The administrative procedure is the most important and basic procedure related to the work of the administration[76], and represents a basic guarantee of protection of the rights and legal interests of citizens and legal entities, as well as the quality of public services[77]. Regulating the way administrative bodies act when applying regulations, and especially their powers, is very important in every community in which these procedures are conducted, be it state, regional, local or even supranational[78]. Therefore, it is and must be at the center of reform processes as a driving force of Europeanization and modernization of administration, but also of society as a whole. In the context of public administration reform and the European integration process, the administrative process should be viewed in a broader context of decision-making, policy-making and simplification of administrative procedures, in order to improve the preconditions for investment and economic development, and harmonization with the administrative standards and practice of the European Union[79]. Administrative procedure is a set of procedural rules on

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[74] „Official Gazzette of Bosnia and Herzegovina, no. 58/14, Official Gazzette of Federation BiH", no. 55/13, Official Gazzette of Republic of Srpska, no. 106/15.

[75] Official Gazzette of Bosnia and Herzegovina, no. 91/06

[76] Lilić S. (2016), „Edukacija voditelja upravnih postupaka i inspektora u Bosni i Hercegovini: Materijali sa provedene obuke sa modelima obrazaca za praktičnu primjenu", Sarajevo-Banja Luka, p. 7. at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiptb6D2MrqAh XS5KQKHZqHCHUQFjAAegQIARAB&url=http%3A%2F%2Fnadzornitimovi.parco.gov.ba%2F%3Fid%3D3354&usg=A OvVaw25TybK_TChCbIvO8RtcpsB (last visited: 13.07.2020.)

[77] Đerđa D. (2011), „Pravila upravnog postupka u europskom pravu", Zbornik Pravnog fakulteta Sveučilišta u Rijeci, Rijeka, p. 109-110.

[78] *Ibid.*

[79] Lilić S. (2016), *op. cit*, p. 7.

the manner of action and actions of administrative bodies when deciding on the rights, obligations and legal interests of natural and legal persons, i.e. when adopting administrative acts.

The most important part of public administration reform in Bosnia and Herzegovina is the issue of administrative decision-making[80]. The Strategy states that the general goal of the reform in this area is to strengthen administrative decision-making and make it a functional, efficient, reliable, transparent and accountable mean of public administration capable of joining the European Administrative Area. The focus of reform in this area should be on simplifying administrative procedures, improving service quality, control, enforcement and capacity building. The goal and focus of the reform are conditioned primarily by the expectations of citizens and business entities that justifiably expect the same or similar level of quality in the provision of public services in each member state of the European Union. This quality is necessary both because of the quality of everyday life and because of the regular conduct of business activities.

General administrative-procedural procedure in Bosnia and Herzegovina is normatively regulated at four levels (state level[81], two entities – Federation of Bosnia and Herzegovina[82] and Republic of Srpska[83] and Brčko District of Bosnia and Herzegovina[84]). All these laws on (general) administrative procedure regulate this matter in a similar way and use identical institutes. However, although very similar, these laws are not identical, and the largest number of interventions was in the Law on Administrative Procedure of Bosnia and Herzegovina. In essence and content, in essential provisions and institutes, they remained faithful, and even identical to the solutions of the former Yugoslav Law on General Administrative Procedure. Bosnia and Herzegovina has a very long legal tradition of regulating the area of administrative proceedings[85], and for more than half a century, in conception and more important institutes, the unchanged legal text governing the administrative procedure has been valid. During that long period of application of administrative-procedural legislation, socio-political and legal circumstances have significantly changed, as well as the expectations of citizens and legal entities.

First of all, Bosnia and Herzegovina is a country in transition from a socialist to a democratic political system[86]. During the long period of application of the law on (general) administrative procedure, the socio-political and legal circumstances in Bosnia and Herzegovina have fundamentally changed, and the understanding of public administration has fundamentally changed. Administrative decision-making is no longer considered a special type of *"exercise of power"* and special *"commanding function"* according to which, on the basis of free (subjective) assessment, it is decided to recognize a right or determine an obligation[87].

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[80] Public Administration Reform Strategy (chapter 4.4. – Administrative procedure), *op. cit.*, str. 39.

[81] Official Gazzette of Bosnia and Herzegovina, no. 29/02, 12/04, 88/07, 93/09, 41/13 and 53/16.

[82] Official Gazzette of Federation of Bosnia and Herzegovina, no. 2/98 and 48/99.

[83] Official Gazzette of Republic of Srpska, no. 13/02, 87/07 and 50/10.

[84] Official Gazzette of Brčko District of Bosnia and Herzegovina - 48/2011 - consolidated text, 21/18 and 23/19.

[85] All countries which gained independence after dissolution of Socialist Federal Republic of Yugoslavia, including Bosnia and Herzegovina, took over into their legal system and continued to apply the then valid Federal Law on General Administrative Procedure. This law adopted by Federal People's Republic of Yugoslavia in 1956 as a federal law and as such was considered the most extensive law of its kind in the world (it contained 303 articles). It was changed and supplemented four times, in 1965, 1977, 1978 and 1986. and was taken into the legal system of the countries formed on the territory of the former Yugoslavia in the version of the consolidated text of the 1986 law.

[86] Đulabić V. (2014), *op. cit.*, p. 10.

[87] Lilić S. (2016), *op. cit.*, p. 7.

Currently, in accordance with modern conceptions, the basic task of the state and administration is to perform "public services" for the benefit of citizens and society as a whole[88].

Second, Bosnia and Herzegovina is in the process of joining the European Union, which, as one of the fundamental conditions, requires a comprehensive reform of public administration, which necessarily includes the reform of administrative decision-making. Given that deciding on the rights and obligations of individuals and legal entities is the largest and most sensitive task of public administration, it is necessary to regulate the administrative procedure in an adequate manner. The reform can also be seen in the process of Europeanization as an institutional adjustment to the requirements of the European Union[89]. By signing the Stabilization and Association Agreement, Bosnia and Herzegovina has undertaken the obligation to harmonize its legislation with the legislation of the European Union, and has begun the appropriate reform processes. In the process of European integration, public administration has a key role because it enables the implementation of the necessary reforms for accession to the European Union, and at the same time ensures an effective dialogue on the accession process[90]. Therefore, public administration reform in Bosnia and Herzegovina is not only an obligation arising from the Stabilization and Association Agreement, but also a precondition for the successful integration of Bosnia and Herzegovina into the European Union. The main goal of public administration reform is *"the development of a public administration that would be more efficient, effective and accountable; which would provide better services to citizens for less money and operate on the basis of transparent and open procedures, while fulfilling all the conditions set by European integration, and which would really become a mean for continuous and sustainable socio-economic development"[91]*. Accordingly, Bosnia and Herzegovina has an obligation to harmonize its administrative-procedural legislation with a number of European standards and principles[92].

Third, social circumstances have changed significantly over time. There has been a rapid and strong development of information and communication technology. Demands for quality administrative practices have become louder, and citizens and legal entities have increasingly pointed out the complexity, formalism and length of administrative procedures, costliness, and especially corruption in public administration. Public administration and its conduct should be brought closer to the citizens, as users of its services. In modern public administration, administrative procedure is treated not only as a formalized legal procedure in which the competent authority decides on rights and obligations, but also as a "service" provided to the "user", i.e. citizen[93].

Finally, the shortcomings of the current administrative and procedural legislation are indicated by the vagueness of certain legal provisions, i.e. their inapplicability to current social trends, as well as the ubiquitous excessive formalism and detailing, which often lead to violation of legal provisions by officials. Violation of legal provisions can often be conditioned by insufficient education of officials who carry out administrative procedures. Although it can be argued that the General Administrative Procedure Act was

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[88] *Ibid*, p. 8.
[89] Musa A. (2014), „Europeizacija i novi upravni modeli: agencije u Hrvatskoj" u: „Europeizacija hrvatske javne uprave" (I. Koprić, ur.), Pravni fakultet Sveučilišta u Zagrebu, Zagreb, p. 169.
[90] Inicijativa za monitoring evropskih integracija Bosne i Hercegovine (2015), *Reforma javne uprave uprave u Bosni i Hercegovini*, Sarajevo, at: http://eu-monitoring.ba/site/wp-content/uploads/2015/07/Reforma-javne-uprave-u-Bosni-i-Hercegovini2.pdf (last visited: 13.07.2020.)
[91] *Ibid*.
[92] See: Đerđa D. (2011), *op. cit*.
[93] Blažić Đ. (2015), „Priručnik za primjenu Zakona o upravnom postupku", „Strengthening the management of EU funds and General Administrative Procedures", p. 13. at: http://www.mup.gov.me/vodici/publikacije (last visited: 13.07.2020.)

a good law in 1956, and even in 1986, when administration was not yet as technically and value-wise complex as it is today, it no longer fully corresponds to changed social circumstances and other legal norms[94].

Therefore, the reform of the current laws on general administrative procedure is required equally by European standards of public administration, good practice of European countries, widely accepted efforts towards administrative simplification, improvement and consolidation of new standards of legislative technique in the European Union, and radically changed internal socio-political and legal circumstances. Furthemore, obsolescence and incompatibility of current solutions with existing social needs and trends, especially having in mind strong development of information and communication technology, is obvious.

Recognizing the need and necessity of modernizing the rules of administrative procedure in accordance with European standards and their own legal tradition, all Western Balkan countries, with the exception of Bosnia and Herzegovina, have adopted new laws on general administrative procedure[95]. The most important motives for fundamental changes to the law on administrative procedure in the Western Balkans are the Europeanization of public administration, and especially the Europeanization of the system of legal protection of citizens[96]. Fundamental changes in the law on administrative procedure in the region have occurred, on the one hand due to the expansion of legal protection in accordance with European conventions and regulations, the case law of the European Court and *soft law* developed under the influence of various European actors, and on the other the need to reduce formalities, enable the development of e-Government, reduce administrative burdens and strive for maximum administrative efficiency within the framework of the rule of law[97].

The principles of European administrative law and European standards can be partially achieved through the current laws on general administrative procedure in Bosnia and Herzegovina, which does not correspond to the intensive Euro-Atlantic integration processes. Therefore, the administrative culture and tradition in Bosnia and Herzegovina need to be harmonized as soon as possible with the elements of European administrative law and practice. In summary, the reform of administrative-procedural legislation in the context of European integration should provide standardization of administrative procedure and contribute to: 1) modernization of administrative procedure, its simplification and increase of efficiency; 2) more efficient realization of public interest and individual interests of citizens and legal entities in administrative matters - easier and more complete realization and protection of both legality and freedoms and rights of citizens in the process of direct application of regulations in administrative matters; 3) establishing a public administration that is oriented towards citizens, providing them with services in accordance with the needs of users, and guaranteeing quality and accessibility; 4) increasing legal certainty and improving the business environment and the quality of public service provision; 5) simplification of the formulation of norms and more logical systematics of legal provisions.

The rapid development of information and communication technology has contributed to the change of the social environment, which are changes to which the public administration inevitably has to adapt. The

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[94] Đerđa D. (2007), „Otvorena pitanja upravnog postupka u Hrvatskoj", Zbornik Pravnog fakulteta Sveučilišta u Rijeci, Rijeka, p. 410.
[95] Montenegro adopted a new Law on Administrative Procedure in 2014, Albania and North Macedonia in 2015, and Serbia and Kosovo in 2016.
[96] Koprić I. at al. (2016), Legal Remedies in Administrative Procedures in Western Balkans, ReSPA, Danilovgrad, str. p.
[97] *Ibid*, p. 159.

current administrative-procedural laws, however, do not provide a legal framework for e-Government and it can be reasonably stated that there is a need to modernize the administrative procedure, especially with regard to electronic communication and the possibility of using information technology. This is especially important for improving the economic environment because the efficiency of management is one of the most important parameters in making decisions about investing and starting business activities. The modernization of the administrative procedure should contribute to the establishment of a modern, professional and efficient administration whose main goal is to adequately meet the needs of citizens and the economy, and to ensure and protect their rights and interests. This also changes the attitude of the state towards citizens and the economy, in a way that the public administration is truly transformed into a service to citizens and the economy. Viewed from the angle of European integration, it is important to emphasize once again that citizens and businesses justifiably expect the same or similar level of quality in the delivery of public services in each EU member state, and that this quality is necessary for quality of everyday life and regular business activities.

The current laws on administrative procedure provide for a relatively complicated, lengthy and expensive administrative procedure burdened with numerous formalities. Excessive formalism can be evidenced by the rich case law, since most administrative acts are annulled precisely because of formal violations of procedure. Long lasting administrative procedures lead to a loss of trust in public administration and the development of corruption, while excessive administrative burdens increase the cost of living and business, which has a negative impact on the lives of citizens and the economy[98]. In addition, in Bosnia and Herzegovina there is a very large, currently undetermined number of special administrative procedures, which regulate certain issues of procedure, often unnecessarily, in a different way compared to the general administrative procedure. The existence of a large number of special administrative procedures further complicates the already complex administrative procedures and reduces the level of legal certainty.

In the Report of the European Commission on Bosnia and Herzegovina for 2016, in part 2.2. Public administration reform – Service delivery to citizens and businesses is stated that *"the current legal framework at different levels enshrines the key principles of good administrative behaviour, but there is room for further simplification of administrative procedures. Special administrative procedures still need to be reviewed and either abolished or brought in line with the law on administrative procedure. Exemptions should be minimised and allowed only when they are duly justified"*.At the same time, the report states that Bosnia and Herzegovina is in the early stage of public administration reform and that the institutional arrangements and resources for the protection of citizens' rights to good governance are insufficient[99].

CHALLENGES IN BOSNIA AND HERZEGOVINA - COMMON AND SPECIFIC

Bosnia and Herzegovina, like other countries in the region, is facing certain challenges in the process of introducing information and communication technologies in the administration, and especially in administrative procedures. Some of them can be called common, since they were, to a greater or lesser extent, present in other countries in the region, while some can be considered as a "specific", because they

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[98] Tomić Z., Milovanović D. i Cucić V. (2017) Praktikum za primenu Zakona o opštem upravnom postupku. Beograd, p. 69.
[99] See: European Commission Report on Bosnia and Herzegovina for 2016 at: https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_documents/2016/20161109_report_bosnia_and_herzegovina.pdf. (last visited: 13.07.2020.)

are particularly characteristic of Bosnia and Herzegovina. In the following, we will present specific challenges, appreciating that a lot has already been written about "common challenges".

What can be asked in the context of Bosnia and Herzegovina is whether the adoption of a set of e-Regulations is sufficient for the effective introduction of information and communication technology in the administrative procedure. In order for e-Regulations to come to life in the administrative procedure, it is necessary to make certain interventions in the administrative-procedural legislation. Given the above, the question arises whether this should be done through a comprehensive reform of administrative procedures or, through the amendment of, we can freely say, outdated regulations.

In accordance with the constitutional order of Bosnia and Herzegovina, as mentioned earlier, administrative and procedural legislation is regulated at four levels: state, entity (Federation of Bosnia and Herzegovina and Republic of Srpska) and the level of the Brčko District of Bosnia and Herzegovina. Although these are different jurisdictions, given that these laws represent the reception of a common, former federal law, they are very similar in content and form. This similarity of laws is at the same time their advantage, but, paradoxically, one of the main reasons why the reform of administrative procedures in Bosnia and Herzegovina has not been approached.

The fact that the same or similar administrative-procedural rules are applied in the same territory creates a sense of certainty and trust of citizens in the legal system. The possibility of applying two essentially different procedural laws (eg the Law on Administrative Procedure of Bosnia and Herzegovina and the Law on Administrative Procedure of the Entities) in the same territory (city, municipality, etc.), with different institutes and protection, can create a feeling of uncertainty among citizens. and distrust in the legal system and the state. Therefore, although there has long been a need to modernize administrative and procedural legislation, especially with regard to electronic communication and the possibility of using information technology, the risk of establishing different legal solutions is one of the main reasons why this reform has not yet been approached. There is no guarantee that the reform of the law on administrative procedure would be simultaneous, nor that the scope of interventions and the establishment of new administrative law institutes would be the same or similar.

The awareness of the representatives of all levels of government in Bosnia and Herzegovina that it is necessary to enter the process of reforming administrative procedures exists, as well as the awareness that these laws must be mutually complementary[100]. There is an awareness of the need to enact completely new and harmonized laws on administrative procedure, which will be based on the idea of protecting the rights and legal interests of citizens and other social actors, which will generally simplify the administrative procedure.

In this sense, the current advantage of Bosnia and Herzegovina in terms of administrative procedure reform is the experience of the countries of the region, which generally have similar legal solutions. The experience of the countries of the region in the process of preparation, adoption and implementation of new laws can and should be a good basis for the reform of administrative-procedural legislation in Bosnia and Herzegovina.

The experiences of administrative bodies during the COVID-19 Pandemic indicate the need to accelerate the process of digital transformation. This has become a clear and definite need of the citizens. Thus, e.g.

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[100] Horić, S., Mehmedović, E. (2017), Zajedničke karakteristike reforme upravnih postupaka država regiona u kontekstu približavanja Evropskoj uniji, *Sui Generis*, vol. 4, no. 4, p. 153.

restrictions on the freedom of movement of citizens, whether for health and / or security reasons, indisputably indicated the need to introduce an electronic signature and electronic document or to introduce work from home. We believe that this challenge can also be used as a trigger to accelerate some long-begun but never-ending processes.

CONCLUSION

This paper sought to point out the specific challenges of Bosnia and Herzegovina in terms of introducing information and communication technology in administrative procedures. They are related primarily to the unreadiness of various levels of government to a synchronized, if not unified approach to reforming the administrative procedures of different levels of government.

There is an indisputable need for the reform of administrative-procedural rules, which, in order to modernize them and harmonize them with European standards, are equally required by the process of European integration, as well as by domestic opportunities. The need to reform the rules of administrative conduct in accordance with European standards is indicated by the fact that all the countries of the Western Balkans, except Bosnia and Herzegovina, have done the same. These reformed laws differ significantly from the provisions of the laws that were previously in force, which is a challenge in their implementation, because in addition to the norms, it is necessary to change the mentality of the administration (concretely acting of civil servants), but also citizens. However, when the preconditions for a unified approach to the reform of administrative rules are created, the experience of the countries of the region in the reform of administrative treatment will be a comparative advantage of Bosnia and Herzegovina. Such experiences in the preparation, enactment and implementation of new laws can and should be a good basis for the reform of administrative procedure in Bosnia and Herzegovina.

The risk that comes with reforming the existing administrative-procedural framework is the possibility of a different approach to reform, non-acceptance of the same or similar institutes, and different standardization of the same institutes. The biggest risk is the non-implementation of the reform at all levels of government, which could have significant legal and socio-political consequences. Due to the needs of citizens and the economy, the adopted regulations is necessary to be, if not identical, then at least complementarity. It should be noted that even in countries that did not have such a challenge, the process of reforming the administrative procedure took a significantly long time (from the drafting of the law to the beginning of its implementation).

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DIGITAL TRANSFORMATION, SUSTAINABILITY AND SMART CITY: A CHALLENGE FOR SOFIA?[1]

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Abstract

The paper studies the nature and interrelations between digital transformation, sustainability and smart city in the light of growing urbanisation and its impact on cities developments, urban services and systems and cities management. The purpose of the paper is to propose recommendations for better city governance in line with recent achievements. It is structured into three parts and focused on the nature and scope of digital transformation, its manifestations and dimensions embedded in contemporary urban governance, sustainable dimensions and city progress assessment, and main findings and insights for Sofia city digital transformation and sustainable governance. The methodology of the study relies on a review of scholarly contributions and literature; it uses official statistics sources on economic and social developments, and digital society as well as data from relevant city development indexes.

Keywords: Smart city, smart sustainable city, urbanisation, urban planning, urban policies

INTRODUCTION

Urbanisation is developing at a rapid pace. If nowadays over 50% of the world's population lives in cities, it is expected to reach 70%, and even more in OECD countries (86%), thirty years from now (OECD, 2019). This growth affects all the urban services and systems such as health care, education, housing, transport and mobility, energy systems and other infrastructure. Challenges emerge at the economic, social, environmental and political level. The potential consequences are dramatic and cannot be further ignored, which necessitates effective and holistic urban planning and management (UN-Habitat, 2019).

An opportunity to address the complexity of urban issues stands up with the intensive development of information and communication technologies which to varying degrees are entering every aspect of the business, economy and society, defining them as digital. In the context of the Fourth Industrial Revolution (Schwab, 2016), the organisations are using data and information resources in a quantitatively and qualitatively new way adopting new business and operating models to create and deliver value to customers and beneficiaries and also establishing new generation partnerships.

This rapid progress of technologies and their widespread and ubiquitous entry into societies and economies in recent years imposed the concept of digital transformation of organisations and its importance for overcoming the challenges of modern development and urbanisation.

As a European capital and largest industrial centre of Bulgaria, the city of Sofia faces similar tendencies and threats. There is a concentration of economic activity in it. Its population has grown by 11% over the last sixteen years. As a result, today almost 1/6 of Bulgaria's population resides in the Sofia area. Ecological and social concerns multiply. The society becomes increasingly digitalised, especially the youth.

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Diverse factors join simultaneously to create pronounced expectations and pressures on institutions and city leadership and authorities for large-scale, multi-faceted and result-oriented digital transformation for sustainable development. Among them are technological advances, growing urbanisation, current trends in urban governance and management for sustainability and transparency, the development of information and communication infrastructure and the rise of the digital openness and culture of the society. Additionally, this process could be catalysed by dynamised entrepreneurial ecosystem (Hadjitchoneva, 2018, 2019) and local businesses, especially the digital-driven ones. Further, if in the last few decades digital activities have primarily stood for better service delivery to citizens and businesses and more effective institutional operations and governance (at least as strategic objectives and regulations), nowadays engines are commonly environmental and social challenges to societies, economies and urbanisation.

In this context, we are committed to the question of the nature of digital transformations, their scope, approaches and stages of implementation to sustain effective urban planning and management and improve well-being and quality of life. How has the city of Sofia been coping with the challenges posed by ever-increasing urbanisation of the Fourth Industrial Revolution and the demand to conciliate digital transformation and sustainability? How has the digital transformation been incorporated in the city's governance?

Consequently, the purpose of the paper is to study and track these developments while analysing and proposing recommendations for better governance. The paper is organised into three parts: (i) nature and scope of digital transformation, its manifestations and dimensions embedded in contemporary urban governance; (ii) sustainable dimensions and city progress assessment; (iii) main findings and insights for Sofia city digital transformation and sustainable governance.

The methodology of the study relies on a review of scholarly contributions and literature; it also uses official information sources and data from the National Statistics Institute as well as relevant city development indexes.

From analogue format, through automation to the digital transformation of the city

Research on digital transformation as a concept has proliferated since 2014 gaining a pic in 2016. Many of the authors are practitioners describing case studies of businesses applications. The conceptual scholarly research and literature reviews are less presented. However, even that the digital transformation is not defined uniquely, similarities in various definitions could be found (Reis et al., 2018): (i) a broad concept that *impacts* policies, businesses and social development beyond the mere transformation from analogue to digital information; (ii) not just automation of processes, but creation of entirely *new opportunities* for business organisations, public administration and social life; (iii) *significantly improvement* through new business models, optimization of operational activities and better customer services; (iv) *radically improvement* of technology delivery and access to businesses; (v) *reroute or new investments* in technology and business models to increase customer engagement; (vi) use of new digital technologies that enable *significant improvements* to impact all aspects of customer life. Therefore, digital transformation is about "*significant/radical improvements*" of models, operations, customer services. We assume that it is equally valid for a diverse type of organisations, whether private or public.

Different stages, focus and maturity of digital progress are clearly distinct in the literature (Savic, 2019; Sun, 2018): (i) *digitisation*, characterised by conversion from analog to digital (readable by computer) format, (ii) *digitalisation* characterised by automation of operations and business processes to the level of

integration and interoperability of information systems; and (iii) *digital transformation* characterised by an overall *cultural and strategic rebirth* of the organisation, centered on customers.

Organisational leadership has to have a shared vision for digital realisation and future state. If during the process of digitisation the challenges are almost material and financial, in the case of digital transformation and its openness and readiness to change, they are related to human capital.

Sun (2018) argues that digital transformation is "*not necessarily about digital technology, but about the fact that technology, which is digital, allows people to solve their traditional problems*" (Sun, 2018: 6). People give preferences to digital solutions over old ones. Kane et al. (2015) also state that digital transformation is not driven by technology but strategy. Therefore, a turning point is to create a strategy that is operational, with the scope and objectives driving digital maturity and transforming the entire organisation, integrating different digital technologies from social, analytics, mobile, and cloud world.

Today's digital reality is tightened to the advancement of social networks, cloud and mobile technologies, big data and artificial intelligence, device connectivity and the Internet of things. They are reshaping the governance of organisations and introducing a new framework for social interactions and consumer experiences. Big data, analytics and artificial intelligence are used as inputs in the transformation system, while the outputs encompass components like industrial internet, sharing economy, digital workforce, machine to machine communication, blockchain, cryptocurrencies, Internet of things structured in a unified framework for digital transformation (Sun, 2018).

Such a combined impact of technology leads to exponentially accelerated progress of higher value to society rather than to organisations (businesses, industries) (WEF, 2016). Public authorities have to bring together political and regulatory aspects with day-to-day operations. The flexibility of policies incorporates identification of necessary policy changes with regard to legal challenges, the applicability of regulations and policy framework to stimulate innovation. Best digital practices provide insights for the better quality of customer service and facilitating access to services. Open standards, effective stakeholder engagement, and business consulting produce major effects. Essential aspects are security, privacy and cross-border data flow, as well as the timely response to coordinate and resolve issues with stakeholders.

The OECD (2016) prioritises "*cities for all*" and "*right to the city*" (UN-Habitat) giving recommendations for implementation of effective inclusive urban growth policies to allow everyone to become involved in the urban development of employment, education, housing, transport, health and environment. Strong partnerships between local authorities and stakeholders, including government institutions, businesses, educational structures, civil society, is recognised. Key steps to sustain changes in cities, along with setting goals and indicators to measure progress, determining the right degree of political intervention, building strategic partnerships at different levels of public authority and society, attracting innovative sources of finances to explore and exploit the potential of digitisation in cities and entrepreneurial energy.

City digital transformation drivers are: (i) *economic*-related with efficiency, productivity, growth, infrastructure, inequality, entrepreneurship, business sophistication, industries, clusters; (ii) *social* related to talents, demography, consumer expectations, citizens activity, civil participation, stakeholders, safety, health, inclusion; (iii) *technological* related to big data, open data, analytics, artificial intelligence, cloud; (iv) *political* related to supranational organisations, initiatives and common policies, accountability, transparency; (v) ecological related to resources management, pollution, catastrophes; (vi) *globalisation* related to information, networks, intelligence, mobility, connectivity. Knowledge, leadership, finances and resistance to change are the main constraints to realize successful digital transformation.

Digital transformation is the way to transform the modern city into a 'smart city' led by data and information availability, knowledge dissemination and digital technologies progress, and established rapidly by scholars and practitioners since the 1990s as a new city planning and development paradigm considering complementary technology-driven and human-driven approaches, also 'systems'-oriented or 'holistic'-oriented based, or hard infrastructure and soft infrastructure founded, developed in a top-down or bottom-up way (Komninos & Mora, 2018). The smart city concept has different understandings and definitions but mostly the same dimensions (Komninos & Mora, 2018; Giffinger et al., 2007; Anthopoulos, 2015). However, there is a unifying point and that are digital technologies or more generally innovations as enablers of changes towards smart city achievements in all aspects of city planning and living.

As multi-dimensional construction, *significant improvements* are needed in several essential characteristics: (i) *economy* aligned to innovative spirit, entrepreneurship, productivity and labour market regulations; (ii) *people*, their qualification, competences and openness; (iii) *governance* and its capacity to be transparent, participative and friendly service deliverer; (iv) *mobility* referred to information and communication technologies and transport infrastructure; (v) *environment*-related to nature, resource management, pollution and protection; and (vi) *living* reflecting to context and conditions of health, education, safety, housing, culture and social inclusion; all of them smart (Giffinger et al., 2007), SMELTS framework for smart city initiative (Joshi et al., 2016) or similar (ITU, 2015; Mundula & Auci, 2016; ITU, 2017).

Ten years ago a smarter city simple approach (roadmap) is already proposed (Dirks et al., 2009), starting with setting of short term and long term goals and strategies, prioritising limited core city services, citizens, business, transport, communication, water, and/or energy systems and activities, and investing in quick successes, integrating, optimising and improving citizen experiences and efficiencies, and getting insights and developing further the all system. Smart governance factors such as collaboration, data exchange, service and application integration, communication, accountability, transparency, participation and partnership and leadership, are major for the vital and successfully implemented smart city initiative (Joshi et al., 2016).

Generic multi-tier architecture for a smart city based on experiences, various case studies and theoretical findings that addresses all potential smart solutions may serve governments purposes for city innovation and sustainability (Anthopoulos, 2015).

Ten standards for smart cities covering smart community infrastructure, open data, sustainable development of communities, infrastructures and universal accessibility, accessible mobility, smart tourist destinations, and smart indicators inventories are published by the European Commission (EC, 2019a).

Various projects and initiatives on the European level enhance the smart city intensification, good practices exchanges and interaction and cooperation between numerous stakeholders. An example of such initiative is the European innovation partnership on smart cities and communities (EIP-SCC) build on the engagement of the public, business and other interested groups to develop innovative solutions and participate in city governance, and aimed at improving urban life through sustainable integrated solutions in ecology (air pollution and clear urban environment), energy (energy costs and efficiency), mobility and transport (congestion and better mobility), and ICT areas (EC, 2019b). Only in 2019, 15 projects have been financed by Horizon 2020 (EC, 2019c); other possibilities were available under T-Ten or Marco Polo Programmes.

Thus, sufficient, structured and easy-applicable frameworks, guidelines and good practices are provided in the literature. They can be adopted and adjusted when starting the overall process according to the goals and context. It benefits the "*smart*" smart city planning shortening its period and reducing the efforts. The objectives of the urban performance towards smart city should go beyond GDP and effectiveness to well-being, happiness and quality of life. Scholars claim that from all characteristics (economy, people, governance, mobility, environment and living), the only smart-people and smart-environment have positive effects on efficiency. A city is smart "*if and only if it is able to be a focus for skilled labour force, ICT firms, honour students, tourists and to implement policies for ameliorating the business environment, reducing pollution, facilitating the development of social capital*" (Mundula & Auci, 2016: 596). Thereby, prioritizing smart-people and smart-environment may assure quick and longlasting effects on the entire ecosystem.

As the smart city concept implies largely social and ecological challenges, often it is perceived as "*smart sustainable*" city charged with understanding to meet the needs of present and future generations with respect to economic, social, environmental, governance and cultural aspects and recognizing proper system of progress measurement (ITU, 2015; ITU, 2017).

We also assume a rather smart sustainable city approach that *considerably encompasses holistic method, impacted by both technological and non-technological drivers, implying the digital transformation to create and innovate the city of the future going beyond the economic efficiency to achieve sustainable competitiveness* (Hadjitchoneva, 2020) *for a high quality of life within a long term perspective.* Therefore, taking into account the acceleration of the urbanisation and the progress of city planning and development concepts, the digital transformation becomes an essential and integrated structural element of the short-term and long-term objectives and strategies of society for a better quality of life.

City progress assessment: city indexes

Cities rankings have their assets and handicaps (Giffinger et al., 2007: 6-8). They serve to draw public attention to major issues of regional science, to stimulate broad discussion on development strategies, to make the decision-makers to make their decisions transparent and comprehensible, to initiate learning effects. The weaknesses consist in propensities to neglect complex interrelations in regional development, to focus the discussions on the bare rank, to threaten the long-term development strategies, to strengthen the existing stereotypes, to ignore the results by poorly ranked cities.

Numerous rankings exist to measure and compare cities' development. Among them are IESE Index Cities in Motion, A.T. Kearney Global Cities Index, Global Power City Index, Global Liveability Ranking, Sustainable Cities Index, Quality of Living City Ranking, Innovation Cities™ Index, Safe Cities Index, and Global Financial Centres Index.

IESE Index Cities in motion covers different key dimensions of metropolises that applies a holistic approach to benchmarking urban performances all over the world (IESE, 2019). It is based on four main drivers: sustainable ecosystems, innovative activities, equitability among citizens and connected territory. The index assesses nine aspects: human capital, social cohesion, economy, public management, governance, environment, mobility and transportation, urban planning, international outreach, and technology. London, New York and Amsterdam hold top three positions for highly developed and smart cities.

London performs on first ten positions in almost all aspects: human capital and international outreach (ranked 1), mobility and transportation (3), governance (7), technology (8), and urban planning (9). The

city is lagging behind in main sustainability challenges: social cohesion (45) and environment (34). London City set up its Smart London plan in 2013 putting citizens and businesses at its core and pursuing the model of open data-talents-networks-innovations (Smart London plan, 2013). Five years later, the new mayor shapes the new even stronger empowered digital transformation of London city (Smarter London Together, 2018).

New York is a leader in economy dimension. Its ranking is high in human capital (3), urban planning (2), mobility and transportation (5), international outreach (8) and technology (11). The main weakness concerns the social cohesion dimension (137). The city launched its road map for digital future in 2011 with four main pillars: (i) more extensive connectivity and access to Internet in public spaces, backed by educational initiatives, (ii) open government featuring application programming interface (APIs) for city and support of needs-based ecosystem of innovation, (iii) engagement and further communication and solicitation of the local community through social media and integrated services and systems, and (iv) industry and technology start-up ecosystem support (The City of New York, 2011).

Amsterdam performs particularly well in international outreach (3), technology (7), economy (10), urban planning (11), and mobility and transportation (11). Amsterdam becomes a data-driven city ten years ago when starts the Smart City initiative, collecting a large amount of data and using it to improve service delivery and make the city a good place for living, working, and doing business (EY Global, 2018). The city relies on strong cooperation and partnership with the private sector in areas as mobility for managing traffic flow in real-time, green living, circular maximizing recycling city, climate street reducing energy use, economy with the launch of Innovation fund, open data available, infrastructure re-negotiated green energy contracts, and living labs to test new projects, resulting in 80 pilot smart initiatives (EY Global, 2018).

Other cities leading first three positions in 2018 in most of the above-mentioned cities indexes are Vienna, Zurich, Paris, Hong Kong, Tokyo, Munich, Osaka and Edinburgh.

Approaches to urban planning vary widely among cities. The New Urbanism introduces globally universal principles to create sustainable, human-scaled cities when policies take into account the primary needs to preserve the natural environment, the history and the critical agriculture, to have nice places to walk and bike, to easily connect and transit, and others (Calthorpe, 2017). Common features in city planning related to authorship, chosen time to make plans and appropriated method to document the accomplishments and the ongoing work, while differences concern the plans horizons, the performance evaluation and tracking, and the involvement of stakeholders in the planning processes and responsibilities for plans execution (Townsend, 2018). Typically, plans are initiated in the second half of a mayor's first term in office and have single authorship of the initiator and performer of the entire plan development. It engages diverse and multiple leading and interested parties, and variety of means of public consultation and communication: private consultations with some influential stakeholders (New York), large steering committee and public hearings (London), more public process and community involvement (Chicago), crowdsourced highly open approach and mostly online (Dublin), and administrative approach as part of an IT budget process (San Francisco). Generic methodology follows three necessary steps: (i) *analysis* of the state of digital and sustainable city, (ii) *engagement* in planning process of citizens, academics, businesses, city employees, technologists and other interested parties to share insights and ideas, (ii) elaboration of *road map* with measures and progress evaluation framework.

Sofia city: pace of change and challenges

Sofia's economic activity is estimated at 40% of the GDP of the country (2019a), concentrating investments and businesses in ferrous metallurgy, printing industry, electrical and electronics industry, chemical industry, textile, construction, food industry and others.

Since 2002, the growth rate of Sofia's population with relation to the total population of the country has been continuously increasing (Figure 1). While in 2002, 15.22% of the total population of the country lived in the capital, in 2018 the figure stood at 18.97% (NSI, 2019b).
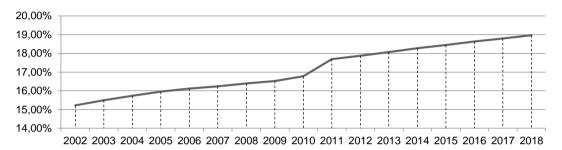

Figure 1. Sofia population versus total population growth rate (2002-2018)
Source: Based on NSI data, author's computation and elaboration (NSI, 2019b).

In 2020, the population living in Sofia will be 19,25%, in 2050 - 24,43%; besides, the structure of the population is changing to the ageing population (NSI, 2019c).

This tendency influences the quality of life in the capital and necessitates adequate city management, policies and planning in all aspects of capital life. More and more challenging become air pollution, traffic jams, and efficient mobility, health and education infrastructures, security.

In 2018, 80.8% of the economically active employed population in the country used the Internet regularly (NSI, 2019d). For students, this percentage reached 98.6%. The proportion of active Internet people increases with younger age. People aged 16-24 are the most active on the Internet (92.2%), followed by those aged 25-34 (86.9%), 35-44 years (80.4%) and so far descending. If we compare the regions in the country, digital coverage and digital activity are highest for the region with Sofia capital – the Southwest region (in 2018, 75.3% of households with internet access, 69.2% of regular Internet users activity). It is revealing for the potential of society to absorb and enhance further institutional digital transformation.

Even though the rankings from year to year are not directly comparable, they provide general information about the position of Sofia towards the cities covered by IESE Index Cities in Motion (CIMI). Overall, the trend is negative, and Sofia's ranking is getting worse compared to all cities covered by the index; in 2017 it is positioned in mid-ranking, while in 2019 it lags behind with a deteriorating score (Table 1).

Table 1: CIMI Sofia Global Ranking and Scoring (2017-2019)

Sofia	CIMI Ranking/Tot	Sofia Rank/Tot	CIMI Scoring
2019	**115**/174	.66	46,71
2018	**101**/165	.61	48,10
2017	**91**/180	.51	61,57

Source: Based on CIMI Reports 2017, 2018 and 2019, author's compilation and computation.

The first five best positions of Eastern Europe cities held by Prague, Tallinn, Warsaw, Bratislava and Budapest (ranked between 51 and 84 in 2016, 48-75 in 2017, 47-73 in 2019) are remarkably better than Sofia's ones. Their ranking trends have been mostly positive for the last three years; for example the best-ranked city Prague is at position 51 in 2016, 48 in 2017, 47 in 2019. Sofia as a medium city (1-5 million inhabitants) is comparable to Amsterdam, Copenhagen, Vienna, Stockholm and Oslo (first five ranked by size).

Assessing the growth trends and potential, Sofia is classified in the least favourable group of "*vulnerable*" cities that did not experience significant changes in the ranking (CIMI Report 2019: 64). It is also a "*stagnant*" city, which achieves poor results in almost all the dimensions analysed (CIMI Report 2019: 65). Sofia has successively worst performances in the economy, urban planning and international outreach of all nine dimensions analysed (Table 2 and Figure 2).

Table 2: CIMI Sofia Rankings by dimension (2017-2019)

Year	Economy	Human Capital	Social Cohesion	Environment	Governance	Urban Planning	International Outreach	Technology	Mobility& Transportation
2019	164	76	87	90	88	149	115	97	82
2018	128	79	95	79	61	138	108	68	73
2017	144	66	69	13	135	71	118	101	105

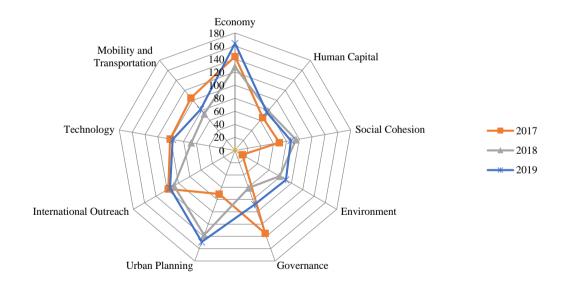Source: Based on CIMI Reports 2017, 2018 and 2019, author's compilation.

Figure 2: CIMI Sofia Rankings by dimension on radar chart (2017-2019)
Source: Based on CIMI Reports 2017, 2018 and 2019, author's elaboration.

The capital's economic performance depends on the overall national economic context and policies to improve the business environment. Reducing the time to start a business, increasing the motivation for start-up activities and making regulatory environment more favourable for creating and developing a company could be quick winners and improve its ranking. As urban planning dimension is closely related

to sustainability and assesses smart city growth, it will be a rapid gain to provide an extensive range of possibilities for green mobility and especially enlarging the bike-areas and increasing the bike activities and availability of bike-rentals and bike-sharing points. Others urban planning possibilities are related to green spaces, housing policies and health infrastructure.

Digitisation, digitalisation and digital transformation are long and sore running processes backed intensively with a large number of strategic documents and regulations since 2002 (Hadjitchoneva et al., 2020). However, this does not necessarily mean proportionally significant progress, more effective and efficient institutions, and smarter governance 17 years later.

Sofia city starts in late 2016 its initiative to achieve a shared vision for future development (Vision Sofia 2050, 2019). The positive aspects are: (i) the understanding to found the organisation and strategy's elaboration methodology on similar initiatives in other well-performing cities following necessary steps of analysis of the state, engagement of community and development of road map, (ii) the efforts to collect large volumes of data and information for backing primary analysis, (iii) the ambition to involve different interest groups in dialogue regimes, (iv) the holistic character with seven fundamental dimensions including people, identity and culture, economy, urban environment, environment, transport and governance, corresponds to modern city smart strategic planning. Generally, it could be stated that every central aspect of smart city development and tendencies with or without digital transformation is present.

Still, there is prolongation in the project implementation. Initially, it was a two-year project aiming to provide Sofia with Sofia smart city plan from the beginning of 2019. Nowadays, dynamics and technology developments force velocity, adaptability and flexibility. Many times "*less is more*" when there are urgent appeals for "*quick gains*" (poor or downward Cities indexes ranking, poor or ingravescent economic, social and environmental indicators, lagging quality of life, the political situation as a time of major term in office or political continuity reserves, others). Smart cities standards, rich research basis and comprehensive similar initiatives and cooperation, could be used largely to fasten the processes substantially. Besides, specificity and specific goals and measures are of most importance since they affirm the meaningfulness of the entire operation to smart city planning based on the *real needs* and *strengths* of the city and its community to move ahead and improve quality of life.

In addition, further bold struggle is needed to attract stakeholders and to involve the local community in an active dialogue with concrete and specific engagements and results of common and commonly supported goals for the future of Sofia. Such an active dialogue arises in parallel with strong credentials and confidence in leadership, reputation and expertise. Scenarios and options simulations, including costs-benefits scenarios, are useful tools during expert and public dialogues and consultation. The effective involvement of academia, professors and researchers in strategic management and relevant city developments pillars overcomes such shortage (see Smart London plan, 2013; Smarter London together, 2018). Similarly, the politicians and the political will are indispensable to support the overall process and achievements, not just participation but intense commitment. The same is true with respect to cooperation with the private sector. A crucial element for successful implementation of short-term and long-term objectives is public-private partnership. It opens straightaway the debate since the early stage for public-private partnership guidelines or respective purposeful policies to induce stimuli for creativity and ventures in a favourable business context.

CONCLUSION

The urbanisation of Sofia is on the rise. Different aspects of it produce a synergistic effect on urban services, systems and management on economic, social and environmental levels. It affects increasingly the quality of life in the capital imprinting its transportation, mobility, environment, economy, social life, education and health systems, and others. In parallel, digital technologies propose multiple solutions to support the challenges of modern city developments. As societies and businesses become intensively digital, so it needs to be the city and its institutions. Since there is a pronounced lag in proper institutional digital advancement, a diversified approach to every singular city development smart dimension may be avail if identifying measures of digitisation, digitalisation and digital transformation pursuant to needs, readiness, and goals of the community.

Flexibility of policy-making permits to win through the dynamism and advance digital transformation for long-term sustainability impacts. Availability of numerous scholarly papers and publications by practitioners on the smart city framework and standards facilitates and significantly accelerates the "*smart*" smart city planning.

 Urban planning should go beyond digital transformation and beyond GDP and effectiveness to well-being, happiness and quality of life. Focusing on smart-people and smart-environment could bring quick and sustainable gains on efficiency. Sources for "*quick gains*" are multiple cities development indexes. Implementing policies for a better business environment, dynamising entrepreneurial spirit and technology-driven start-ups, reducing pollution, facilitating the development of social capital, enhancing skilled labour force, attracting tourists are smart solutions that should be prioritised. Sources are also people. However, productive dialogue needs credentials, high expertise and active political engagement.

Smart city initiatives visualise the culture and the ambitious of the society for a better life. Its understanding of the shared success is so much valid as it is its lack of understanding for the shared failure. It is as simple as to decide what city we want and to unit around clear and straight messages and objectives, then to fix the short and long run priorities and to execute properly the plan established.

Current research opens the doors for further research to deepen notably the analysis in every dimension of Sofia smart city current state and prospective development.

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DIGITAL TRANSFORMATION AND INNOVATIVENESS OF ENTERPRISES*

Stanisław ŁOBEJKO[1]

Abstract

We are witnessing the digital transformation of the economy, enterprises and the whole society caused by the fourth industrial revolution. Our world is becoming more and more digital. Digital technologies change enterprises and their business models, which are increasingly adapting to the needs, expectations, and requirements of consumers. They allow in an unprecedented way to involve the consumer to the process of creating new products and services. At the same time, we see progressive globalization, opening markets and growing competition. This new reality changes the rules of the market game, business models and methods of competition. Among the competitiveness factors, competing with innovations is at the forefront. It is increasingly emphasized that in the future only innovative enterprises will win competitive struggle. Therefore, the main objective of the chapter is an attempt to assess whether and how the digital transformation will affect the innovativeness of companies. There are two main research questions related to this: 1. Does, and how does digital transformation affect the company's innovation? and 2. Can the digital transformation change the structure and way of running a business so that innovation can be more closely related to the entrepreneurial attitude of employees?

It was formulated and evaluated the thesis that the digital transformation of the company does not guarantee the growth of the company's innovativeness, but its absence will be a strong barrier to the innovation. The second thesis assumes that thanks to digital transformation enterprises can be more innovative and their employees more entrepreneurial. To think about innovations, companies should make a technological transformation that allows them to take full advantage of the opportunities that digital technologies offer in business. The analysis of the impact of digital transformation on the innovativeness of enterprises will be carried out from two perspectives: a macro - digital institutional transformation of the economy and micro - digital transformation of the enterprise.

Keywords: Digital transformation, innovation, entrepreneurship

INTRODUCTION

For several decades, we observe the rapid development of digital technologies, which significantly changed both the social sphere and economy. Today, the digital revolution has a significant impact on all areas of life, changing the existing rules of functioning of markets and enterprises. Enterprises that want to be competitive in the digital economy need to make a digital transformation. The digital transformation of enterprises and especially business models means that there is an urgent need to develop and implement new methods and techniques of company management. It is also a new challenge for business management science. According to Schumpeter, every entrepreneur is an innovator and thanks to entrepreneurs, economic development takes place [Schumpeter, 1912]. His theory gained special significance in the second half of the twentieth century, when after the period of the Cold War there was

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a rapid economic development of the world. Its driving force has been scientific and technical progress and dynamic development of technology. Influence of information and communication technologies, the Internet and wireless communications have had a particularly strong impact. Thanks to modern technologies, the world has become different in many aspects, but it involved the creation of computer networks enabling faster information exchange and virtualization of enterprises' operations. Further development of information and communication technologies enables the emergence of social networks and as a result, the world becomes a "global village" in which everyone can communicate with each other in real time, regardless of where they are at a given moment. All this causes that the conditions of enterprises' operations change, which in this new reality must find their way of development.

The rapid development of digital technologies has been observed for many decades. This development has influenced and significantly changed both the social sphere and economy. Today, the digital revolution has a significant impact on all areas of life, changing the existing rules of functioning of markets and enterprises. Enterprises that want to be competitive in the digital economy need to make a digital transformation. The digital transformation of enterprises and especially business models means that there is an urgent need to develop and implement new methods and techniques of company management. It is also a new challenge for business management science.

The role of the government

The phenomenon of digitization is not only modern, super intelligent technologies but above all the socio-economic phenomenon affecting the civilization development of the world. It is expected that the result of the ongoing digitization will be the accelerated development of the digital economy, digital society, and digital state, which will be based on artificial intelligence. The digital state, which thanks to digital technologies can become a leader and organizer of change processes facilitating the development of the digital economy and digital society, has a particularly important role to play. Thanks to the digitization of administrative and management processes digital state will be the driving force for the development of new business models and the growth of enterprises' innovativeness.
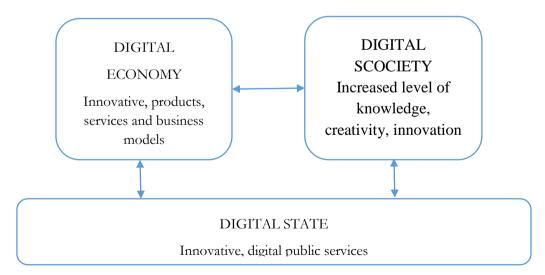

Figure 1: A digital state as the foundation for the development of enterprises' innovativeness

In the digital age, data have an increasing impact on innovation processes. Digital technologies reduce the costs of access to data and information needed in innovative processes. As a result, the costs of personalizing products and introducing them to the market are significantly reduced. The increasing availability of market and consumer data and the increasing easiness of their application in innovation processes helps improve process and product innovation. Product cycles are shortening, and speed of market competition is increasing. "Data have become a major input to innovation: basic data on the characteristics of materials or the environment, or on customer demand, can be used to identify a product's optimal features and create "digital twins" of machinery and digital goods, allowing deeper forms of process optimization." That is why, as part of the government policy supporting the digitization of the economy, the state plays an increasingly important role in the processes of developing the innovativeness of enterprises. State activities supporting the creation of digital information services and information exchange platforms may have a positive impact on the transfer of knowledge needed for the proper functioning of innovative processes. Thanks to them, digitally transformed enterprises gain easier access to global information networks, public science and research centers, scientists, freelancers and can use them to solve various difficult problems related to creating innovations and their dissemination.

Providing innovative public services with various channels and means of electronic communication will bring tangible benefits to citizens and entrepreneurs. However, the lack of digitization of the state or its slow development results in slowing down the digitization of the economy and society. Therefore, it is necessary to systemically transform the rules of functioning of the public sector considering the perspective of the entire state, not individual units.

The concept of digital transformation

The digital transformation of each organization is a transformation of its resources, structures, and principles of functioning to take full advantage of the opportunities offered by modern digital technologies to become more and more effective. As a result, public sector organizations should provide services in the form of an integrated, multi-channel approach (traditional and digital), based on personal, postal and network contact (on-line, mobile access, digital TV). An important feature of the digital transformation of the state is that the citizen is treated not only as a client (recipient) using public administration services but above all as the owner and participant in the process of creating digital public services.

At the micro level, digital transformation is very often perceived as the implementation of digital technologies in all areas of the company's business operations. Thinking about digital technology, we assume that it supports discovering new boundaries and using innovations and technologies to push business into new directions. Digital transformation offers new opportunities for an existing service to design and deliver better customer experience thanks new ways of interacting with clients. They are many different definitions of digital transformation. A simple definition of digital transformation determines it as the novel use of digital technology to solve traditional problems. But digital transformation is also defined as the integration of digital technology into all areas of a business, fundamentally changing how company operate and deliver value to customers. In another words we can say that digital transformation includes all changes associated with digital technology application and integration into all aspects of human life and society. It allows to move from the physical to the digital. The definition of digital business transformation proposed by Gartner is: "digital business transformation is the process of exploiting digital technologies and supporting capabilities to create a robust new digital business model". It can be said that digital transformation refers to how a company has or is transforming its core business

processes using digital technology to gain competitive advantage and strengthen collaboration and interaction between its partners as well as offer greater value to the customers. "According to IBM research, companies seeking opportunities in an era of constant customer connectivity focus on two complementary activities: reshaping customer value propositions and transforming their operations using digital technologies for greater customer interaction and collaboration."[2] Digital technologies facilitate contact and establishing cooperation with clients at any time when value is created. This close cooperation with the client allows the creation of a new customer-oriented business model that accelerates the development of innovation through online communities. Companies conducting digital transformation as the main goal should focus their activities on optimizing the value chain around increasing customer engagement. Saul J. Berman in his publication emphasizes that: „Transforming the customer experience is at the heart of digital transformation."[3]

The adaptation of products and services to the digital economy is one of the most important challenges for business managers. The company's digital transformation can ensure its continuity in the market in the future, but it does not guarantee the uniqueness or destructive impact on the market or industry. For many managers, digital transformation is associated with a breakthrough in business and is in fact a follow-up to changes caused by digital disturbances.[4] "Companies will continue to develop many great products using a deep understanding of customer needs and well-managed development processes."[5] Digital technologies make it easier to identify unmet consumer needs and individual expectations. It becomes possible thanks to the use of information technologies to acquire, collect, and process large data sets. The digital recording of data and information allows the use of Big Data analytics, data mining and enables the creation of information supporting company management. Detailed information about the consumer's needs allows the company to implement a development strategy based on personalization of products. That is why we are observing the still growing demand for timely and exact information about the needs of the consumer. It should be emphasized that, apart from the known ones, there are also more difficult to recognize unarticulated customer's needs. In the field of high-tech advanced products, consumers' knowledge about the needs they meet may be poor. These new needs for customer can be created by a company offering a modern, innovative product, providing a new quality for market.

The current, rapid development of digital technologies covers all areas of life and business activities of companies. Thanks to digital technologies, the digital transformation of enterprises is taking place, involving the introduction of disruptive changes in the approach to clients and conducting business, which result in the creation of innovative products, services, processes, or business models. „Forged by digitization, ubiquitous connectivity, and globalization, this transformation will radically alter the very nature of the firm and how it creates value. No industry is immune to this trend."[6] Digital technologies and advanced systems based on artificial intelligence accelerate robotization, which will not only enable the replacement of human work with the work of robots, but also contribute to increasing the efficiency

[2] S. J. Berman, *Digital transformation: opportunities to create new business models*, Strategy & Leadership, Vol. 40 Issue: 2, 2012, pp.16-24

[3] G. Westerman, D. Bonnet, A. McAfee, *Leading digital technology. Turning technology into business transformation*, Harvard Business Review Press, Boston, Massachusetts, 2014, p. 29.

[4] J. Kletzkine, *Digital Transformation Doesn't Mean Innovation*, https://www.forbes.com/sites/startupnationcentral/2018/05/31/digital-transformation-doesnt-mean-innovation/#ad710487c0f5 , Access February 28, 2019.

[5] *Revolutionizing Innovation. Users, Communities and Open Innovation*, ed. D. Harhoff and K. R. Lakhani, The MIT Presse, Cambridge 2016, p. 474.
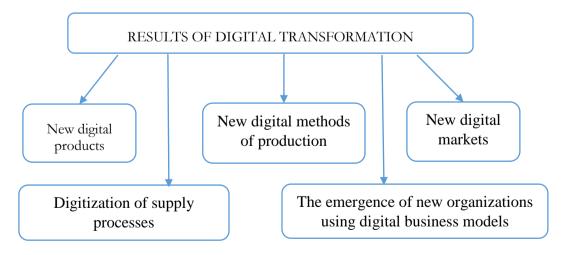
[6] C. K. Prahalad, M. S. Krishnan, *The new age of innovation. Driving co-created value through global networks*, McGraw Hill, New York 2008, p. 11.

and quality of manufacturing processes. Intelligent robots with the ability to machine learning not only can replace a human being in performing simple repetitive activities, but thanks to learning skills they will be able to improve their work and acquire new skills enabling them to perform creative work exceeding the capacity of the human mind.

Digital transformation and innovation

Quite often the concept of innovation and transformation are treated as synonyms, but in fact, only in some cases these concepts are equivalent. In most cases they differ fundamentally. Transformation is usually a process that lasts a certain period, while innovation may appear as a result of a sudden spark or creativity. The difference between concepts is particularly evident in the case of digital transformation, which means the process of technology implementation improving business to make better consumer experience. It can include improving operational efficiency, changing the company's culture and image its structure and a business model.

Schumpeter understood innovations extensively as: (1) the introduction of new products or the improvement of existing ones, (2) the introduction of a new or improved production method, (3) the opening of a new market, (4) the use of a new way of selling or shopping, (5) the use of new raw materials or semi-finished products, (6) the introduction of a new production organization.[7] With regard to competition on the market and treating innovation as a competitive advantage factor, innovations can be divided into five categories: (1) a new product, (2) new method of production, (3) new market, (4) new source of supply for materials/pre-manufactured goods, and (5) the emergence of new organizations that create or abolish monopolistic market structures. In digital economy each category can have a destructive impact on the industry, sector, or whole economy. Innovations in a company can play a dual role: supporting already existing on the market innovations and destructive, replacing these innovations. In the contemporary digital economy, the sixth category is becoming increasingly important: digital technologies. This category includes all technologies, methods and technics broadly understood as digital technologies.

RESULTS OF DIGITAL TRANSFORMATION

New digital products

New digital methods of production

New digital markets

Digitization of supply processes

The emergence of new organizations using digital business models

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[7] J. A. Schumpeter, *The theory of economic development. An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, Transaction Publishers, New Brunswick (U.S.A) and London (U.K.), 1934, p. 66.

Figure 2: The impact of digital transformation on the company fields of innovation

In a modern, competitive economy introducing disruptive innovations is one of the ways to gain lasting competitive advantage on the market. In this context, the need to have an innovative business model of the enterprise is increasingly pointed out. „Business model innovation is the conscious change of an existing business model or the creation of a new business model that improves its functions and satisfies customer needs better than the existing business models."[8] Currently, competition between companies takes place not only at the product or service level, but also at the business model level, and creating such a business model that differs from the competition is a big challenge for many companies. In the world of hyper-competition and hyper-acceleration of business activities, traditional business models are forgotten and are replaced by new digital models, more flexible and better suited to the era of digital transformation. The digital transformation of enterprises opens new opportunities in the design and implementation of innovative business models that become a guarantee of market success. It applies to innovative enterprises that, thanks to innovative digital business models, increase their innovativeness. "Business model is considered as an important vehicle for innovation but also a source of innovation in and of itself, namely a business model innovation."[9] Business model innovation enable creating new product or service that is so different from current that requires radical changes in enterprise.[10] Thanks to digital transformation capabilities business model innovation facilitate customer value creation as a core competency across industry, revenue and enhance firm capacity to innovate.[11] "Organizations who leverage the disruptive business model innovation create significantly better products and services and are able to offer a better customer experience."[12]

Digital transformation affects both the way companies operate and their business models. It enables the introduction of completely new, previously unknown business models based on digital technology platforms, which allows them to gain a competitive advantage. The term digital technology platform is understood as common infrastructure necessary for many applications supporting a product or group of products.[13] Digital platforms, enabling the use of common infrastructure for developing applications, benefit from the multiplier effect that arises thanks to the synergy resulting from the cooperation of many partners. As the experience of many companies shows so far, disruptive innovations that break the existing order in the industry or sector and introduce new business rules as well as new business models will

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[8] M. Edwards-Schachter, *The nature and variety of innovation*, International Journal of Innovation Studies Volume 2, Issue 2, June 2018, Pages 65-79.

[9] Ibidem, Pages 65-79

[10] W. Duggan, *Creative Strategy. A guide for Innovation*, Columbia Business School Publishing, New York 2013, p. 60.

[11] *Digital transformation. Creating new business models where digital meets physical*, IBM Global Business Services, IBM Institute for Business Value 2011, p. 11, https://s3-us-west-2.amazonaws.com/itworldcanada/archive/Themes/Hubs/Brainstorm/digital-transformation.pdf, access 2020.04.05.

[12] *Re-thinking the European Business Model Portfolio for the Digital*, BearingPoint Institute, https://www.bearingpointbeyond.com/files/BearingPoint_Institute_Report_New_Digital_Business_Models.pdf, p. 3, access 2020.05.10.

[13] A. Agarwal [2018], *From product to platform: The secret to building A $10 billion SaaS business*, https://www.forbes.com/sites/valleyvoices/2018/08/14/secrets-to-10-billion-saas/#1ce9e5e77df6, access 12.12.2018.

become more important for the company success on the market.[14] It should be emphasized that new business models based on digital platforms will be accompanied by changes in the organizational structures of enterprises from hierarchically organized towards flat structures based on teamwork.

More and more new business models, thanks to the combined use of the potential hidden in technologies and digital platforms together with traditional solutions, products, or services, reorganize relations with physical goods, enabling them to replace their property rights with access rights. In the Uber model, the car driver is the owner who provides a means of transport through a technology platform that supports the entire customer service process, including not only his transport from point A to point B, but also ordering the service, tracking the order or making online payments. In the case of such business models in terms of competition, it is not only about lower service costs, but above all about the comprehensiveness and quality of the service, which contribute to the positive experience of the consumer. Digital platforms also allow you to learn about the experiences of consumers using them, becoming the company's most valuable resource, enabling customer relationship management and preparing the offer to its expectations. Thanks to understanding consumer experience related to products and services offered on digital platforms, it is possible to create and introduce innovations that meet customer expectations. Digital technology platforms are becoming the basis for creating innovative products and services in all industries. This also applies to the healthcare sector, in which business models based on digital platforms are being developed, enabling diagnostics and remote health control.

Digital platforms can play important role in transformation all industries. According to de Reuver et al.'s[15] the digital platforms can play disruptive role in shaping entire industries. Parker also points the emergence of platform thinking about the transformative and disruptive impact of digital platforms on organizations and their business models and the business environment as a whole.[16] All this means that research on new theories and models which will explain and predict the potentially disruptive nature of digital platforms will be needed.[17]

There is no doubt that we live in a world where everything is changing, and the only thing that is constant is the process of continuous change. For many years, we have been observing changes taking place in business models driven by new technologies, new methods of production, distribution, and marketing. These factors not only modify already existing models but also allow the creation of entirely new business models. One of the main driving forces behind the process of change are digital technologies that force businesses to change their existing model of operation to a completely new one. Such a change is possible thanks to the digital transformation of enterprises enabling shift from their traditional mode of operation and management to the modern and technology-oriented ways of operation. Delivering a good digital business experience to customers and employees is the main goal of the changes that are taking place. Strong market competition makes it necessary to reduce operational costs and enhancing customer experience in effect of digital transformation.

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[14] C. M. Christensen. *The innovator's dilemma: when new technologies cause great firms to fail*, Harvard Business School Press, Boston, Massachusetts, USA 1997.

[15] M. de Reuver, R. C. Basole, C. Sorensen, *The digital platform: a research agenda*, April 2017, Journal of Information Technology, p. 7.

[16] G. G. Parker, M. W. Van Alstyne, S. P. Choudary, *Platform Revolution: How Networked Markets are Transforming the Economy and How to Make Them Work for You*, New York, WW Norton & Co., New York 2016.

[17] M. de Reuver, et al. Op. Cit. (2017, p. 7-8)

Digital destruction and company innovativeness

It can be assumed with certainty that the digital transformation of enterprises will be the key factor conditioning the company's development in the conditions of digital disorders in all areas of its functioning. Currently, long-term development of the company is not as it was formerly linear but changing as the movement of waves. Companies introducing new products or services to the market do not wait for them to finish their life cycle, but earlier withdraw them from the market, introducing in their place better (improved) products. Hence the ability to create innovation is impossible without the ability to destroy, and the condition for achieving a state of lasting innovation is the strategy of persistent imbalance, associated with the destruction of what exists to free space for what is to be created.[18] Many companies will soon face a dilemma: whether to destroy the existing balance in the industry or wait for another company to do so. The digital transformation of a company can facilitate the solution of this dilemma by enabling digital disturbances of the existing state of equilibrium thanks to innovative digital business models and innovative digital products and services. It will allow to focus on understanding current and future digital innovations and their application in companies.

Today many of contemporary disruptive innovations are based on new, highly advanced technologies and on digital technologies. Digital technologies are now becoming one of the main drivers of economic development and the foundation for the fourth industrial revolution and a new industry known as Industry 4.0. Today, it is hard to imagine the functioning of a modern economy without digital technologies. Their influence on the economy is more and more often destructive but in a positive sense because destruction can have a creative character.

According Schumpeter, creative destruction is the process of change and adaptation of actual industries to novelties.[19] Schumpeter considered creative destruction as a process that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly a new one. Emerging innovations cause destruction of old products and processes.[20] In his view of economic equilibrium important role plays consumer with their unmet needs and demand. Consumers' wants are fundamental force for theory of circular flow in economy and businessman acts using means and methods of production to meet consumer needs.

As shown by the previous experience of many companies' digital technology allows to transfer many of the market mechanisms to an online, real-time auctioning system. Using this idea, Uber built a business model, creating a digital technology platform enabling through intermediation between customers needed car transportation and drivers having unused or underused capacity with their personal cars. Digital technology platforms play a very important role in this process. They are the foundation for the development of new business models, offering new opportunities to meet identified market needs as well as create completely new needs and even new markets. The real time auctioning system now is being expanded to many areas of the economy. An interesting example of using new possibilities created by digital technology platforms and auctioning systems is Haier Group Corp., which is transforming itself

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[18] K. Kelly, *New Rules for the New Economy. 10 Radical Strategies for a connected World*, Penguin Books 1999.

[19] H. Schneider, *Creative Destruction and the Sharing Economy. Uber as Disruptive Innovation, Edward Elgar Publishing 2017*, chapter 3, pages 63-91.

[20] J. A. Schumpeter, *Capitalism, Socialism and Democracy*, 2nd ed., Harper & Brothers, New York 1947.

into a platform for entrepreneurship and his employees into self-governing entrepreneurs.[21] Strong market competition forces companies to take actions to increase their efficiency. This goal can be obtained in many ways and one of them is the reduction of fixed costs. Another action leading to the same goal is to increase the flexibility and agility of the company's operation, its connectedness to the market. All this becomes possible thanks to the use of digital technologies and the transformation (transformation) of a traditional company into a digital company. "In its transformed state, Haier is no longer a traditional manufacturing corporation so much as a platform that provides financing, support, and coordination for microenterprises focused on developing products and services for the "smart home", the internet of things (IoT) – based concept of a fully connected and networked household".[22] For this purpose, the company has implemented a new management model called *Rendanheyi*, thanks to which the company is closer to the end user of its products. As a result, the company can increasingly engage consumers to co-create new innovative products and services. The Haier digital platform not only allows better use of internal resources but also thanks to the platform availability to external entrepreneurs interested in cooperation, it enables the use of external resources and human potential of the whole world. In this way, the company is transforming into a network organization. There are more and more companies, which thanks to digital technology make the transition from structural to network organization. Digital transformation that is driving this transition creates powerful new capabilities for company development and market competition. Digital transformation based on artificial intelligence, robotics, cognitive computing, Big Data, and Internet of Things helps companies to optimize their business to meet consumer demands and experience. Digital companies can serve many customers immediately and at very little cost. They can compete in new ways thanks to use of converging digital technologies and new data sources. Due to the simultaneous implementation of a bundle of digital technologies many of traditional businesses are being crushed by the digital companies as Uber, Netflix, or Amazon.

Table 1: Innovation and entrepreneurship in companies

The period of development	Innovation and entrepreneurship
Until the end of the first half of the twentieth century	Entrepreneur as an innovator creating and commercializing innovations. Close links of innovation and entrepreneurship. Schumpeter's view - an innovator entrepreneur who effectively uses production factors, providing innovation to the market, drives economic growth.
Second half of the 20th century	The following separation of innovation from entrepreneurship. The innovations are dealt with by specialized company employees (engineers) developing highly advanced technologies. The innovator ceases to be an entrepreneur.
The beginning of the 21st century	Transformation of companies based on digital technologies. The use of digital platforms allowing the transfer of some managerial competences to employees, forcing them to be more independent and expecting entrepreneurial attitudes. Back to the idea of Schumpeter in the new version - an enterprising employee innovator. Factors of production owned by the company, which becomes a network of employees, teams and individuals cooperating on the digital platform, as well as consumers who are co-creators of innovation.

Source: own elaboration.

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[21] P. Michelman, *Leading to Become Obsolete*, MIT Sloan Management Review, Vol. 59, N0. 1, Fall 2017.
[22] Ibidem

An important issue for any contemporary company is its innovation. As shown by Schumpeter in his work, the entrepreneur, thanks to his involvement and skills in using the production factors: land, labor, and capital, creates new entities, new products and services, and even markets. Thanks to his creativity, innovations arise, and he is an innovator who contributes significantly to economic development. For Schumpeter, an entrepreneur is an innovator. One can draw a conclusion about the bottom-up nature of innovation, closely related to entrepreneurship. The history of business development is going through stages starting from a small company, through a medium to a large, global corporation. Analyzing the essence of innovation, it can be demonstrated that in the way of company growth, the idea of innovation begins to break away from entrepreneurship. In a small and medium-sized company, the entrepreneur is the driver of its innovation. However, growth of the company usually makes that innovative activity begins to separate from the business activity - innovation is handled by employed for this purpose engineers, who need not to have, and often do not have the features of an entrepreneur.

Analyzing the digital transformation of the Haier company, it is possible to formulate the conclusion that digital technologies and digital technology platforms offer the possibility of return to the original idea of entrepreneur as an innovator. In the new digital model of the company based on the digital platform, each employee becomes an entrepreneur and at the same time has the opportunity to create innovation in close cooperation with the end-user, and thus be an entrepreneur and innovator. It follows that the future of enterprises is the ever-increasing digitization forcing flattening the hierarchical structure and making greater independence of the units (teams). Thanks to this, the employee is not anymore only the executor of orders of his managers and, gaining more and more independence in making decisions, they must become more and more entrepreneurial. It can therefore be assumed that in the twentieth century there will be expected a return to Schumpeter's idea of an innovator entrepreneur, in a new form in which not only an entrepreneur (company owner) is an innovator, but also every employee of a large corporation is an entrepreneur and innovator. And what is more, thanks to digital technologies, this enterprising employee-innovator will be very close to the consumer who will become a co-creator of innovation.

Digital transformation enables a company to implement new digital forms of cooperation in the field of consumer experience, services based on data and conversion of resources, leading to the acceleration of the process of creating breakthrough innovations. As highlighted in the report The *Fourth Industrial Revolution* "when firms share resources through collaborative innovation, significant value can be created for both parties as well as for the economies in which such collaborations take place"[23]. Digital transformation of enterprises is a prerequisite for implementing collaborative innovation.

A particularly large impact on the company's innovation has the company's digital transformation in the field of co-creation has. Co-creation is one of four categories of new opportunities and imperatives for innovation listed in The Bright Stuff.[24] In the process of co-creation, thanks to close ties with the consumer, it is possible to use consumers as a supplier of new ideas or solutions and to incorporate consumers into the company's innovative processes by engaging their attention and realizing that they may affect the final products offered on the market. Digital transformation requires an appropriate technological infrastructure (ICT) also known as e-infrastructure covering distributed networks, computers, storage devices, software etc. These e-infrastructure facilitates collaboration among research

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[23] K. Schwab, *The Fourth Industrial Revolution*, World Economic Forum 2016, p. 57, https://luminariaz.files.wordpress.com/2017/11/the-fourth-industrial-revolution-2016-21.pdf, access 2020.05.15.
[24] A. De Meyer, S. Dutta, S. Srivastava, *The Bright Stuff. How innovative People and technology can make old economy new*, Pearson Education Ltd, London 2002, p. 134

communities by sharing resources, analysis tools and data and supports the development of inter-organizational cooperation and cooperation with suppliers, subcontractors, and consumers. Technologie cyfrowe umożliwiają współpracę, tworzenie sieciowych powiązań biznesowych oraz konsumenckich. The new value arises because of the company's network cooperation with its suppliers, wholesalers, agents, R&D sphere, and consumers. Networking is now becoming the best way to increase enterprise innovativeness. Thanks to this the company can compete by offering innovative solutions giving new value to the consumer and a better experience. Fast developing networks using the latest digital technologies are the driving force for the emergence of innovation in the digital space based on digital relationships between companies, organizations, and institutions, and individuals.
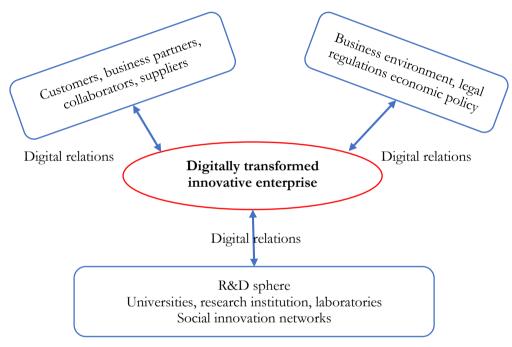

Figure 3: The space of digital relations of an innovative enterprise

It should be also noted that in the conditions of continuous technological change and changing market economy, e-innovations are becoming increasingly important. „E-innovation is a new idea – a new label for a group activities whose aim is to create new tools for innovation, product development and business development in the present climate of continuous change."[25] A particularly important factor supporting the development of innovation in an enterprise is the creativity of people involved in innovation processes. The emergence of digital technologies and their use in an enterprise raises the question of whether and how digital technologies can affect the creativity and innovation of enterprises. To some extent, the answer to this question is given by the concepts of e-creativity and e-innovation. „E-creativity relies on Artificial Intelligence (AI), which emphasizes defined operations hey can yield same sorts of ideas that are produced by creative human beings."[26] Advanced research and implementation works on artificial intelligence

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[25] B. Cotton, *E-Innovation*, Capstone Publishing, Oxford 2002, p. 14.
[26] K. Siau, *E-creativity and e-innovation*, The International Handbook of Innovation, Elsevier Science Ltd 2003, p. 258.

algorithms and neural networks point to the growing possibilities of using digital technologies in the processes of creating innovative solutions, products and services. The concept of e-innovation is closely related to digital technologies and includes innovations related to online business, content delivery, search for ideas, marketing, and e-commerce. A large part of e-innovation is associated with electronic platforms providing content, serving as a place to exchange ideas, make contacts and broadly understood cooperation. The impact of digital technologies includes business models that will transform from traditional ones into new ones based on digital technology platforms, just as Google, Apple or Uber are already doing. The term digital technology platform is understood as a common infrastructure necessary for many applications supporting a product or group of products.[27]

SUMMARY

Digital transformation of enterprises is the novel use of digital technologies to realize traditional and create new business processes. It should be remembered that digital transformation is not only a transfer of all processes to the digital format, but above all a significant change in thinking about the company's functioning, its processes, products (services), partners and consumers. This requires a new look at the entire company, its business environment, and the business model. Taking this into account, it can be assumed that many elements of digital transformation are innovation. On the other hand, the digital transformation of a company can positively affects and be source of its innovativeness.

The conducted considerations based on the analysis of many publications and the results of published studies as well as the author's own research allow to formulate the following guidelines for entrepreneurs, who are thinking about the digital transformation of their companies[28]:

- The rapid development of digital technologies is observed, and the full use of the opportunities offered by these technologies requires digital transformation of enterprises.
- A systematic increase in the use of digital technology is observed in enterprises from various industries and sectors.
- Digital technologies are a prerequisite for the development of innovation in enterprises operating in the knowledge-based economy.
- Thanks to digital technologies and digital platforms, it is possible to develop cooperation (co-creation) processes supporting company innovation.
- The implementation of a digital technology platform in an enterprise requires a new look at the current organization and functioning of the entire enterprise.
- Digital technology platforms enable the construction and implementation of innovative business models.
- New, digital business models are becoming an important factor in the competitiveness of enterprises in the product and service market.
- Innovative business models based on digital technology platforms are often disruptive to the industry or sector, and thus allow the enterprise to gain a competitive advantage.

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[27] A. Agarwal [2018], *From product to platform… Op. cit.*.
[28] S. Lobejko, *Zarządzanie firmą w gospodarce cyfrowej* w: *Inżynieria zarządzania, Cyfryzacja produkcji, Aktualności badawcze 1*, red. naukowa R. Knosala, PWE, Warszawa 2019, s. 171-179.

- The success of the new business model based on the digital technology platform requires a new approach to management based on the idea of agile management and systemic organization of work in an enterprise.
- To take full advantage of the opportunities offered by digital technologies to enterprises, not only new methods, tools, and management practices are needed, but also a new approach, engaging employees in management processes and encouraging them to creative activity.

The development of digital technologies cannot be stopped and their impact on the economy, society and enterprises will be stronger and stronger. Referring to Schumpeter, the entrepreneur was considered as an innovator and innovation as the driving force of economic development. The digital transformation of enterprises opens new opportunities for them in creating innovations and means that not only the entrepreneur but also every employee, business partner or even consumer can be an innovator. The sooner the digital transformation of the company occurs, the greater will be the chance to increase its innovation and soon there will be no turning back from this process.

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OBJECT KPIs FOR THE DIGITAL TRANSFORMATION

Frank JORDAN[1]

Abstract

KPIs (key performance indicators) are currently widely used in the industries at management level and in the toolkit of the consulting companies. However, they are interpreted by humans, and humans act on the results based on the experience of an individual. What is good, bad or underperforming is determined by fixed set points based on recognized industry benchmarks. Dynamic set points that are based on individual company or market circumstances are not common or even unheard of.

KPIs are not automatically fed back into the control cycle of managing a company or an operational plant by a computerized business model. In general, they are high level in nature and do not go down to the nucleolus of the production process and operating plant equipment. Therefore, simplifications and reduction of data are necessary to make it manageable for decision-makers.

However, in the time of cloud computing, deep learning, and AI science, it is possible to analyse the performance of infinitely small parts/equipment of a processing plant. The resulting data can be amalgamated from the bottom up to give precise results, the possibility to act instantaneously and the ability to identify the root cause of any issues.

This article intends to offer potential solutions to how KPIs can be utilized for the digital transformation of any industry for improving processes and business opportunities.

Keywords: KPI, Object KPI, digitalization, digital transformation, deep learning, AI science, dynamic KPI set points, automate feedback, adaptive KPI, automatic process KPI generation, KPI tracking, and KPI evaluation

INTRODUCTION

Key performance indicators (KPIs) or scorecards have been used since the 1950s and enjoy great popularity in all industries today. Most consulting companies are using KPIs as their base toolkit to advise clients on how to monitor, track and improve their business. It has become a culture to expose working processes and company success rates to employees, and the walls of office entrances are plastered with scorecards and KPI charts.

However, an active self-automated optimization process utilizing those KPIs has not yet been implemented. Instead, it depends mainly on the goodwill of the people and the interpretation of the managers to improve a process. KPIs are abstract and do not give any direction on what the employees or managers should do to improve them. Furthermore, they do not indicate where the root cause of the problem is [7,8].

For instance, if one KPI indicates a negative trend, this trend can be understood by everyone. However, the root cause and the corrective actions required are not apparent and depend on the interpretation by

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the individual. Generally it takes a significant amount of time to realize that the trend is negative, and an even longer period of time to initiate a corrective response.

Consulting companies can be hesitant to agree with this and could argue, they have appropriate processes and methods in place to discover those trends in a timely manner. However, this is again reliant on human-resources and very time-consuming. The usage of their "tools" is binding resources and thus delaying the opportunity for the management to take corrective action.

The objective of this article is to analyze how KPIs can be enhanced and used as part of an automated (computerized) algorithm to interact with the business directly. The definition of these indicators, whether it is a lead, lag, RI, PI, KRI, KPI, etc. [1,2,3], is not relevant because this article will demonstrate how attributes can be attached to indicators to give a machine a holistic view into the business process. Therefore, all indicators become no key performance indicators and will be evaluated in real-time and are part of a new reality.

Classic KPIs

Measurement initiatives are often coupled together without proper knowledge of the organization's critical success factors and an understanding of the behavioral consequences of certain measures. [9]

In the process industries, KPIs are associated with equipment packages.

As an example, we will investigate an instrument air system installed in a plant.

The instrument air package consists mainly of a compressor which produces compressed air for a plant as auxiliary air to drive valves. Although the system is not very complicated, it is critical to the business, as without it, there is no production.

Consequently, the availability should be more than 98%, and if it is an excellent performer, it should be above 99%. In order to reach this availability, there is usually a redundancy measure provided; in other words, a second compressor.

A plant can have hundreds of performance indicators. Therefore, it is beneficial to give them self-explanatory names like IAS1 and IAS2 (instrument air system 1 and 2).

As timebase, this example uses one year which is equal to 8760 hours per year.

The KPI IAS1 will measure the time during which no alarm or fault has been activated against the total time in operation, which is an indicator for the healthiness of the system.
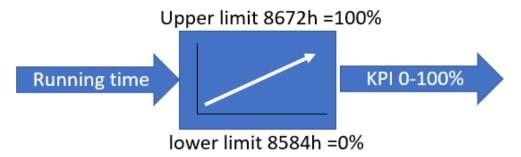
Upper limit 99% of hours per year equals 8672h

Lower limit 98% of hours per year equals 8584h

Slope = 0.011363636

Intercept= -97.5455

This KPI is considering the running hours, which can be counted by a SCADA system and feed into the linear formula.

Upper limit 8672h =100%

Running time → KPI 0-100%

lower limit 8584h =0%

As a result, the compressor is reliable and performing well if its KPI is close to 99% working hours per year, which corresponds to a KPI value of 100%.

If the running hours are closer to 98%, the compressor needs too much maintenance and has a bad performance KPI which is 0%.

The KPI IAS2 will measure the operational scope of the compressor design. Under normal conditions, one compressor can replenish the instrument air vessel and maintain the system pressure. In a scenario where the second compressor is needed more, it can be considered that the instrument air system is running out of the design scope due to leakages or compressor problems.

IAS2 will measure the running time of compressor one, two or both against the running time of both compressors.

$$Running\ ratio\ in\ \% \ = \frac{T(C1\ or\ C2) - T(C1 + C2)}{T(C1\ or\ C2)}$$

(C1, C2 = Compressor 1 / 2)

Therefore, the limits are defined as:

The upper limit is 90% of the time one compressor is sufficient
The lower limit is 100% of the time one compressor sufficient
Slope = -0.1
Intercept= 10

IAS 2 will be recorded after each trigger of the compressor until both compressors are stopped.

As we can see with IAS1 and IAS2 we will get a KPI which is measurable and clearly defined. However, how can we decide that the compressor needs to be replaced because the maintenance cost is too much? Even if two compressors are similar over the lifetime of a plant they will act differently.

We can decide based on a holistic, fact-based criteria wether we will let one compressor run more than the other compressor in order to reduce the overall cost of maintenance and increase the uptime of the plant.

The result is precisely measurable without any manipulation, but the final decision in the context of the entire business is subject to personal interpretation, rather than objectively considering the whole enterprise.

For a machine or an artificial intelligence, it is not feasible to make any conclusion if there is no reference or rule available which determines what should be done in case of good or bad performance.

The upper and lower limit is fixed and chosen based on benchmarks, that are used in similar industries. There is no possibility to individually tailor the classic KPI based on business needs, CAPEX (capital expenditure), OPEX (operational expenditure), available spare parts, logistics and supplies, and available human resources.

Therefore, classic KPIs have a lesser value for the digital transformation of the industries.

Object orientated KPIs

As we have shown, the classic KPIs have no attributes which makes it hard for a computer system to evaluate, define or recommend strategies to improve the business. There is no feedback loop to adapt to set targets or limits.

The goal is to have a KPI with associated attributes which can be evaluated for a business model. The KPI attributes can be fed into a computer model which represents the business of the company. The business model is purely a mathematical model where all known factors or KPIs should be fed into. With rules and formulae compared against a knowledge base, the output will guide the company on what would be the course of action at a given time to prevent degradation of the business.
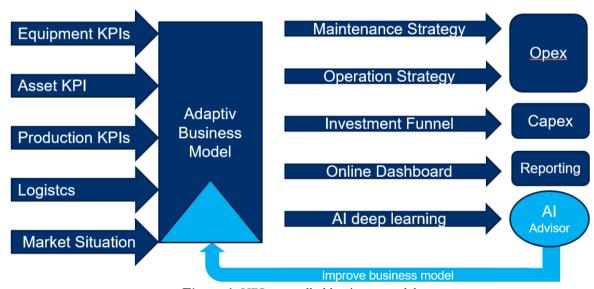

Figure 1: KPI controlled business model

As we can see (Figure 1), multiple parameters and attributes will be required to feed into a business model to represent a company in detail from bottom up.

Computers should collect the data required in order to accurately represent the status of the company.

For instance:

- Most manufacturing plants already have an asset management system in place, but it depends on specialists to make the decision on what is essential.

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We need attributes for each equipment for:

- ➤ meantime between failure
- ➤ spare part availability
- ➤ maintainability
- ➤ cost
- ➤ meantime to repair
- ➤ redundancy
- ➤ process conditions
- ➤ importance for the business

- The assets have different values, but the KPI of the equipment does not take care of the importance of this package.

We need attributes for each asset for:

- ➤ priority for the business
- ➤ value contributes to the company
- ➤ maintenance schedule
- ➤ turnarounds
- ➤ …

It becomes evident that the number of data multiplied by all the equipment parameters of a company are huge and cannot be tracked, and analysed by a human being.

It would be an immense effort to maintain constant repetitions and analytics manually to predict anything out of this data.

Therefore, the performance indicators are recommended to be reduced to 10 [9] in order to make it manageable and be called <u>key</u> performance indicators.

However, with modern computer capabilities, it is not a problem to handle extensive data. With cloud computing, the performance is almost unlimited and affordable.

Once the data is evaluated, the result could be fed into a business model to directly steer:

- the day to day operation
- maintenance activities
- repetitive and planned works
- investments of the company
- reporting focused on hot spots
- continuous improvements required

The key performance indicator becomes an object KPI and is measured in real-time.

Digital transformation

Now let us assume we have all data available in a digital format, what infrastructure would we need to evaluate the data?
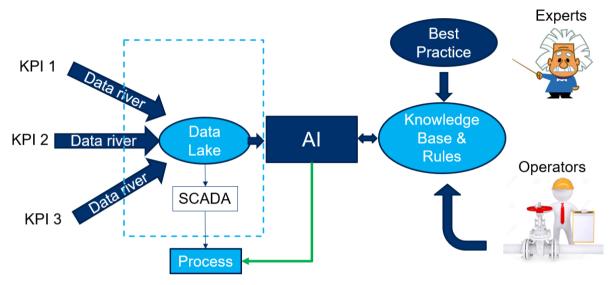

Figure 2: KPI data collection, evaluation by AI

Similiar to a human brain, the information needs to be available in one location which is accessible for the artificial intelligence (Figure 2).

The work can now be segregated between:

- repetitive or known work done by computers
- creative work done by humans such as:
  - define what would be the ideal case or best practice
  - rules of the business
  - experience or restrictions

The artificial intelligence (AI) is searching for known events in the data lake. The AI is comparing the data with the knowledge base.

Once there is a known scenario identified, it triggers an event with fixed rules and measures to be executed.

Therefore, we can assume that the actual work will be executed:

- ➢ best practice based on all known information
- ➢ no violation of the rules
- ➢ consistent quality of work, no mistakes, no human error
- ➢ no complacency, no time delay
- ➢ no health and safety compromise
- ➢ full transparency

Based on the history and trends of the KPI attributes, they should be continuously updated and refined to make better predictions and corrective actions. The AI will feed back and modify attributes to enhance the efficiency of the business.

Object KPI for fully automated maintenance process

For a better understanding of the benefits, we shall demonstrate how the Object KPIs are implemented into the maintenance strategy of an operating plant.

The IT infrastructure of a plant is broken down into several layers:

1. field layers consisting of all field instruments, process value, and diagnostics
2. control layer consisting of SCADA, HMI, and IT networks
3. asset management level (AMS) and maintenance management system (MMS)

The SCADA (supervisory control and data acquisition) or HMI (human-machine interface) system provides the interface for all data or process values to humans to act on and evaluate manually. If there is any corrective action required, it can be manually entered into the MMS (maintenance management system), and the work-order is generated to be executed. Depending on the understanding of the maintenance planner and the breakdown of the maintenance structure the equipment will be repaired.

How the plant should work and what to do in an emergency is described in an operating manual. The main work of the operation staff is to monitor the process, read alarms and find anomalies that are occurring. Once an abnormality is found, it should be acted upon based on the operating manual or according to the experience of the operators. This process is not free of human errors, and it is hard to expect humans to prevent an accident. Due to cost-cutting and reduction of personnel, the pressure of the individual has increased, which contributes to an increased risk of severe accidents.

Due to disasters in the industries, humans are no longer considered as a safeguard for a plant [Shell DEP]. Safeguards are a higher level of automation and protection, but there are still operators involved.

For ideal operation, failures should be eliminated, and work should always be executed in the same safe way and to the best benefit to the business.

With full automation, the majority of an operator's involvement can be reduced. However, in a failure scenario, the situation still depends on humans to decide.

The analytics and diagnostics in modern equipment is very advanced, and it sends an error message with detailed information to the AMS about the status of the machine. However, a human has to look at the condition and make a decision about the necessary action.

In an ideal unmanned plant (no operators), the equipment which is going to fail, triggers a process which decides on the criticality of the action to be taken:

1. the machine is so essential that it has to be replaced, repaired immediately
2. the repair can be done at the next planned maintenance schedule
3. the repair can be done at the next maintenance campaign

For improving the performance, the emergency case should be minimized because it has a direct impact on the business and the company can only react to the effects.

High plant availability should be planned and maintained by a computer-supported maintenance regime.

Usually, the maintenance schedules are fixed, and they do not consider how the equipment has performed in between. Therefore, unnecessary maintenance work will be done. With Object KPIs it can be decided according to which category the equipment should be maintained. For instance, if a transmitter is stable working and no anomalies are detected, it is unnecessary to perform maintenance on it. The risk of causing a failure by disassembling and reinstalling it is higher than the risk of doing nothing at all. There is a huge potential in cost-saving if the individual part's performance decides if maintenance is required.
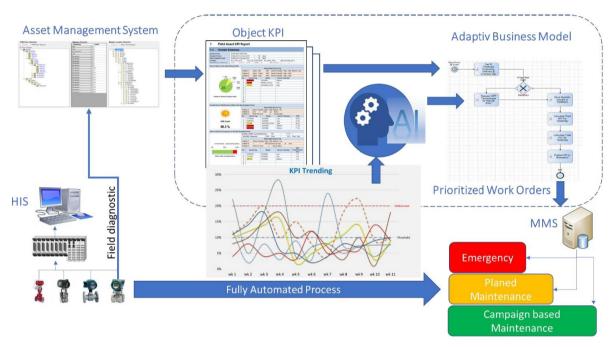

Figure 3: Digitized work process for AI-controlled maintenance

The Object KPI of the individual instrument or equipment will include all parameters which a computer system needs to know in order to understand what the importance of this equipment for the business is. With its holistic view of the situation (access to all data) it will automatically select the best solution which has been pre-determined by experts for this particular equipment.

The reaction of the plant and the object KPI will be trended, so that the individual object KPI can be continuously adjusted based on real-time data from the plant.

Consequently, there is no delay, no HSSE violation and no mistake with the execution. The AI system will improve its knowledge and enhance its prediction capability as well as the business opportunities with each event.

As a practical example, let us assume we have a pressure transmitter installed in a plant from the same manufacturer and same type.

Depending on the location where the transmitter is installed, it might fail more frequently than at another site.

The vendor will give all transmitters the same MTBF (mean time between failures), disregarding any differences in temperature, vibration, and process conditions.

Therefore, if we want to predict the maintenance interval of the transmitter, we must consider all these parameters and adjust the maintenance interval as per the conditions of the individual transmitter. Any opportunity should be used to keep the plant uptime high. Therefore, each shutdown or unplanned stop should be used for maintenance.

With a flexible, individual equipment-oriented maintenance schedule determined by the object KPIs of each equipment, the handling of the maintenance schedule will be very complex. If the business is to benefit from predictive maintenance, a machine has to make these calculations and decisions.

The AI system will learn from experience and improve the transmitter KPI attributes accordingly as well as determine the individual maintenance schedule.

The acceptance of flexible maintenance schedules that are based on predictive maintenance controlled by object KPIs requires a radical, new way of thinking.

Possible benefits

The shareholder will benefit from the new concept in the following ways:

1. Reduced OPEX
   a. significant reduction of operators and experts over the lifetime of the plant
   b. personnel is focused on maintenance and assisted by an AI system
   c. predictive maintenance is based on real-time data and not statistical benchmarks. Therefore, it is best-practice for the specific plant and not just for an average plant.
   d. knowledge is machine-based and continuously available over the lifetime of the plant
   e. improved uptime of the plant's business
2. Clear facts and priorities for the investment funnel.
3. Best practice for the plant with the lowest possible CAPEX.
4. Optimally adjusted business model to ensure the best profit.
5. Leading indicators which come directly out of the process ensure the fastest possible reaction times.

CONCLUSION

The enhanced object KPI model, in combination with modern computer science, has the potential to improve businesses significantly. It can be integrated into a fully automated plant and, together with an online evaluated business model, steer OPEX, CAPEX, investment funnel and reporting actively.

Consequently, object KPIs for individual equipment business elements are the prerequisite for deep learning (machine learning) and thus required for artificial intelligence to be integrated into a business process for decision making.

Object orientated KPIs are not fixed to a certain business, they can be applied to all kinds of industries which are undergoing the evolution of digital transformation.

Companies that follow the way of the digital transformation can anticipate an improvement of their business by more than 5-10%. It is a substantial improvement to beat the market and survive the coming age of the digital transformation.

However, only companies that can utilize the new object orientated KPIs to their maximum potential and integrate it into their business model will have success with this technology. Naturally, experts and out of the box thinkers are also required to make it successful.

Top management can focus more on the business und will be less involved in curing symptoms. Based on hard facts gathered in real-time, management can act instantly to the best of the current situation.

The consulting industry of the future will focus on how to teach the machines, drive the plant or business instead of writing procedures for humans.

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