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Digital transformation of healthcare services: Case study on services of verification and issuing orthopedic and medical aids

Goce Gavrilo¹[0000-0002-0316-6052], Irena Stojmenovska²[0000-0001-9914-5856], Tiedong Ma³
and Vladimir Trajkovic⁴[0000-0001-8103-8059]

¹ University American College, School of Computer Science and Information Technology
Skopje, Macedonia

gavriloigoce@yahoo.com

² University American College, School of Computer Science and Information Technology
Skopje, Macedonia

irena.stojmenovska@uacs.edu.mk

³ Chongqing University, School of Automation Chongqing,
Shapingba District, China

tdma@cqu.edu.cn

⁴ University "Ss. Cyril and Methodius" Faculty of Computer Science and Engineering
Skopje, Macedonia

trvlado@finki.ukim.mk

Abstract. Digital transformation is influencing every facet of peoples live, including the individual and collective healthcare. In the healthcare area, digital transformation has a significant role for scientists and practitioners as for in increasing the quality of the healthcare systems. The paper's main objective is to overview the of the impact of digital transformation on some services that offers Health Insurance Fund, especially on the quality of services. People with disabilities and people who need specific aids in particular areas or periods need support or assistance in performing various daily tasks. The utilization of digital transformation in some internal processes can improve the whole service, discard various problems, and positively impact the quality of lives of all citizens.

The authors presented a research study based on the process of digital transformation in the National Health Insurance Fund (Healthcare Fund) and data and documents analysis of internal processes. The analysis shows that digital transformation affects positively citizens, (insured people of Healthcare Fund), orthopedic companies, and healthcare facilities when using the services and rights from the healthcare insurance and fulfilling obligations.

The example of digital transformation and the results from its, presented in this paper can take from healthcare authorities in decision and health policy making.

Keywords: e-services, healthcare, digital transformation, orthopedic and medical aids.

1 Introduction

As a result of world globalization and the fast advancement in information technology and new innovations related to information technology, the healthcare sector has been changed dramatically over the past ten years in many countries worldwide. The increase of numerous digital technologies such as Multifactor Authentications, artificial intelligence, Internet of Things (IoT), and blockchain technology offers new business opportunities and revenue growth in many sectors if implemented strategically and appropriately. Digital transformation (DT) is a process that arises as a consequence of the application of these technologies [1].

Different processes which as a goal have set it improving an entity by causing significant changes in its properties through using the information and technologies as computing, communication, and connectivity are related to DT [2].

DT has influenced many aspects of a company's work, such as designing digital strategies for growth, acquiring digital resources, the change of internal structure of organization, and the setting of proper targets and metrics for measuring them [3]. The rising relevance of DT in the healthcare industry became apparent to scientists and healthcare practitioners [4].

Many systematic literature reviews about DT in healthcare, including Marques and Ferreira [5], show the incensement of the research papers on this area over the last twenty years. Their research highlights the most common research topics related to technology in the field of healthcare. Different reasons are existing why key healthcare stakeholders have been slow to adopt health information technologies and take advantage of the opportunities afforded by DT [2], while Hermes et al. [6] have systematically reviewed the reasons for such slow adoption. They indicate four main reasons for this: First is the complexity of healthcare and constant interaction across various individuals and organizations. The second reason is the adoption of health IT which powerful actors in healthcare delivery often resist. At the same time, the third is the patients themselves, which are another significant cause. Finally, healthcare information technology is an important factor in the slow DT of healthcare.

The DT of healthcare cannot be covered by a few activities and steps because it's a complex and multifaceted process. This is the case when trying to interpret new developments as technology-related. Technology-related developments include big data and predictive analytics, self-tracking and self-monitoring, different healthcare applications, e-health and m-health services, different medical research, e-patient associations, electronic health or medical records, and co-decision during the determination of making in diagnosis and therapy.

In the field of digitalization and DT, the public sector lags behind the private sector in all European countries. The digital transformation of public administration is an urgent issue in highly developed countries [7]. Some of them, such as Germany, have consistently been ranked in the low-to mid-layer of rankings of digital government. It is for these reasons that digital transformation is a top priority in all highly developed countries.

In the last couple of years, many public organizations in Macedonia created the basis for digitalization and DT by modernizing their information systems [8].

As a government and public institution that takes care of health insurance rights, the Health Insurance Fund has implemented several successful initiatives for digitalization and digital transformation [9,10]. However, these initiatives are not entirely realized for the full digitalization of services, especially in the verification and issuance of orthopedic devices.

People with disabilities are the same as other people. Nevertheless, in certain areas or periods, they need support or assistance in performing certain daily tasks that other people perform without assistance. Fifteen percent of the world's population has some disability, claims the World Health Organization in its report [11]. It includes impaired vision, hearing impairment, people with physical disabilities, and people with intellectual disabilities. Disability does not differentiate between gender or age. People with disabilities can be found in every age group, both men and women. Unfortunately, prejudice, stigma, and denial of access to health services are still present for this category of citizens. Our purpose is to pay attention, especially to this vulnerable category of citizens, to facilitate their access to certain services and improve the use of their rights in the field of health care.

In this paper are presented the effects of digitalization and DT of service for verification and issuance of orthopedic and medical aids. Also, we propose a new concept of these processes based on digital transformation. In next section 2, related work are presented.

Section 3 presents a brief description of the service. The proposed new digitalized model of service after conducted digital transformation is described in section 4. In section 5, the evaluation and discussion are made to the influence of digitalization and DT for this service. The conclusion section concludes the paper.

2 Related work

Advances in technologies and digital transformation have opened the door to the digital age worldwide because of having an insatiable desire and need for quick access to information. One of the phenomenon that has emerged in the 21st century and is present in all traditional industries is the digital disruption. Digital disruption affects all levels of business and society [12]. The very introduction of digital solutions in organizations requires systematic approach and changes in the way of working, the roles, and business offers [13]. The rapid growth and advancement of digital technology had declined healthcare costs. On the other side, health economics worldwide faces huge challenges in solving the problem with the increased costs of providing better quality of the healthcare. It seems that it is necessary to solve such challenges with the introduction and development of digital technology [14].

2.1 Digitalization and Digital transformation

In general, DT represents the set of activities for improvement of business activities connected by digitization. According to various research on daily habits and needs of

the population, industry, authorities, and other stakeholders, DT is expected to be driving force in many areas of everyday life. Usually, dominant tools for mastering and managing digital change are projects for digital transformation and because of that managing of DT is a critical task for project and product managers.

The term digital transformation (DT) can often cause confusion especially when used as a synonym with the terms digitization, digitalization. They are described as follows [15]:

- "Digitization" is frequently used to create a digital representation of bits and bytes for analog/physical things (mostly paper documents, photographs, sounds etc.).
- "Digitalization" is used to describe a set of activities of process for creating a digital representation (document imaging) of a scanned document, a photograph, or another digital file. Digitalization most commonly used to enable, improve, and transforming business operations or functions, processes or activities, by leveraging digital technologies.
- "Digital Transformation" exceeds the previous two terms and can address the effect on an organization due to the re-engineering of business processes based on digital technologies.

Different researchers have diverse views on the process of DT. Some of them consider DT as a mechanism of increasing the organization's presence on social networks and by implementing new technologies that will enable increasing the satisfaction of stakeholders and the quality of products and services [16]. Majdalawieh [17] considers that DT is in fact the profound transformation of business and organizational activities, processes, competencies, and models to fully leverage the options of digital technologies.

The process that has a goal to improve an entity by causing significant changes to its properties using a combination of information, computing, communication, and connectivity technologies represents digital transformation [2]. In particular, some researchers present DT as the integration of digital technologies into business processes of economy [18]. However, in no case the term DT can be equated with the term business process management. For these reasons, Gartner Inc. [19] introduces a new definition in 2018 which is related to digital business transformation. According to Gartner the method of manipulating of digital technologies and support of capabilities to build digital business model represents digital business transformation.

2.2 Digital transformation in the healthcare system

Digital transformation (DT) affects all sectors of everyday life, undoubtedly including the health sector as well. One of the primary DT step in the healthcare area was considered the introduction of the healthcare information system. Moreover, DT and new technologies are changing the whole healthcare scenario. Different technologies, such are: Cloud computing, cybersecurity, artificial intelligence, robotics, augmented and virtual reality, big data analytics, additive manufacturing, wearables and sensors, genome sequencing, and blockchain-based technologies [20], are affecting the way surgeons and healthcare professionals work, as well as the healthcare processes in the sys-

tem, particularly those that can be simplified with the adoption of information technologies. Hermes et al. [6] in their research indicate that the digital transformation of healthcare leads to many novel market segments with new generic roles and value streams, but also overlapping the difference between information technology and health care. While some services do reengineering of existing solutions by digitalizing and digital transformation, others used digital innovations to offer new medical services. But at the same time, some market segments offer new digital services to solve problems that have existed before DT. However, the implementation of technological innovations must be seen from the point of view of improving the process itself [16].

Garmann-Johnsen et al. [21] have shown that DT and innovation in healthcare can be increased by involving employees in the co-creation process using web 2.0 technologies. While Burton-Jones et al. [22] claim that part of the problem including those who are already involved in the process they need a better language to describe what is going on and better insights for improving the work affirming/concluding.

3 Services of verification and issuing orthopedic and medical aids

As an example of DT in healthcare, we use verification and issuing orthopedic and medical aids.

We note that the right to orthopedic devices is exercised under the Law on Health Insurance and the Rulebook on indications for exercising the right to orthopedic and other devices. An integral part of the Rulebook is the List of orthopedic devices in which the deadlines, medical indications, and the manner of exercising the right are determined.

To support the services of verification and issuing orthopedic and medical aids, a centralized IT system with an e-services software solution implemented in the Healthcare Fund have been used [10].

In continuation, we give a brief description of the process which consists of two sub-processes [23]. The First is verification of orthopedic and medical aids through the e-services software solution and the Second - records of issued orthopedic and medical aids from orthopedic companies' side. The issuance of orthopedic and medical aids from the orthopedic companies is based on with the issued and verified certificates.

The current process involves two possible cases:

- completely electronically when the doctor and/or specialist possess a digital certificate; and
- entirely via paper's manual procedure in the cases when the doctor or specialist doesn't own a digital certificate.

These two cases of the particular process are shown on Figure 1.

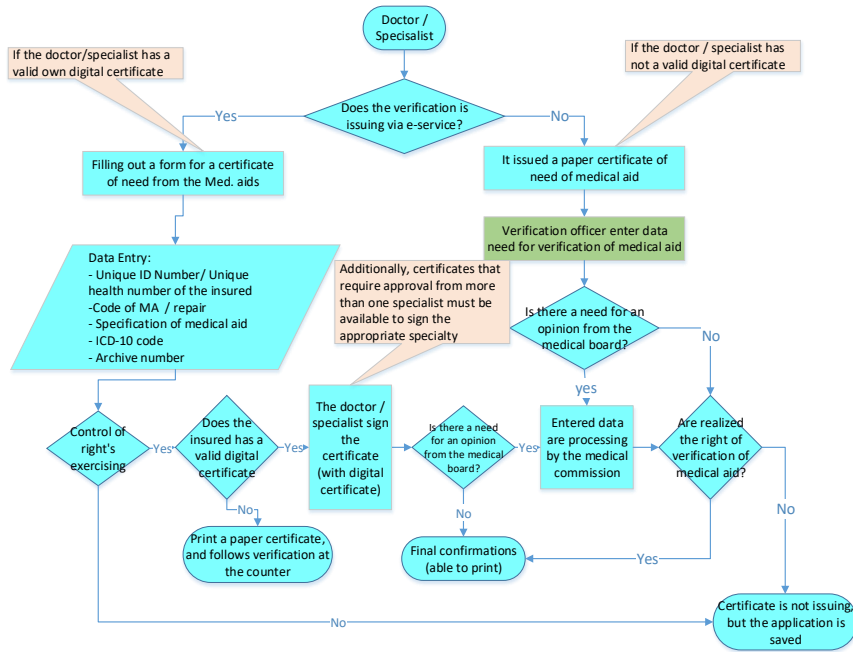


Fig. 1. Process of verification of orthopedic and medical aids [23]

The issuance of the orthopedic and medical aids (see Figure 2) begins with start of initiation of a purchase or order the device or the aid in a specific specialized orthopedic company. An authorized person from the related orthopedic company can search (by login on the e-services software solution) the certified confirmation for the insured citizen (by its unique health or ID number), also can search by the number of the certificate. This person marks the certified confirmation as: issued aids, ordered medical aids, canceled orders, or unreleased aids. An insured person with a valid digital certificate sign the issuance or purchase of orthopedic or medical aid. Otherwise, it's printing the paper certified confirmation, and the insured citizen sign a paper document to prove the reception.

orthopedic and medical aids or issuing them. A short-lived certificate and regular certificate are identical [24]. The short time validity period (a few days) of the short-lived certificate is the only difference from regular certificate. Although these certificates expire in the short time, they do not close after the expiration on the customer's deadline without the need for a revocation mechanism.

A service provider should provide so-called short-lived digital certificates for this type of certificate.

We propose to use some type of Software as a Service (SaaS) for signing system, which will represent a complete solution for following document status, approving of documents with advanced features of digital signatures. This signing system has integrated trusted timestamps services to time-sensitive transactions. A brief description of our conceptual proposal is given in Figure 3.

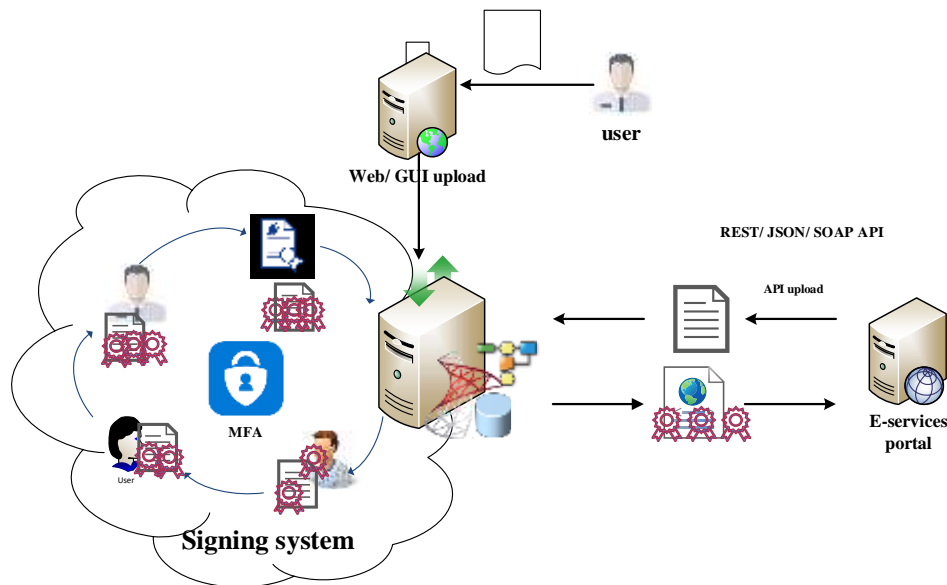


Fig. 3. SaaS signing platform

To support signing procedures, we need to use a multifactor authentication system. Multifactor Authentication (MFA) represents a platform for users' authentication that supports several different authentication and verification mechanisms and methods. MFA system will provide scalable, trusted, and centralized authentication of users as well as stable management platform with the identity-check.

Web applications can leverage the MFA system to verify the credentials and authenticity of users via multiple different form factors. Some of these multiple form factors are: combination of User and Password, SMS-OTP (One Time Password), Mobile OTP, FIDO (Fast ID Online), OCRA Token, and QR code (see Figure 4).

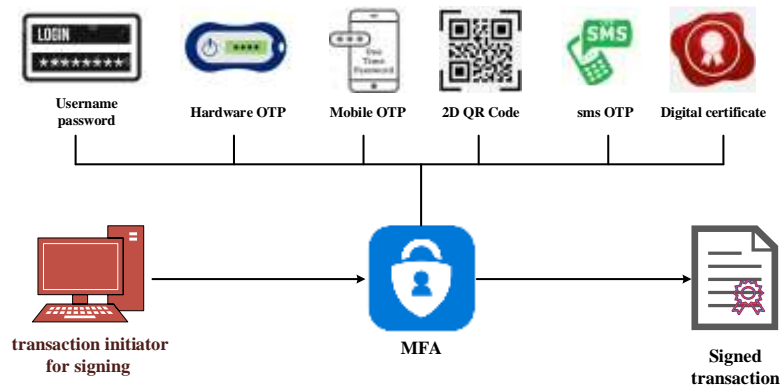


Fig. 4. Multifactor Authentication system

5 Evaluation and discussion

Previous two sections describe services of verifying and issuing orthopedic and medical aids offered by the Healthcare Fund after implementing the digitalization process and future planned DT.

Next, it will be compared these services in 3 stages: the process of digitalization itself including DT, after the process of digitalization, and finally after the DT. The advantages of digitalization and DT versus conventional paper-based services will be covered with the evaluation, described below. It will be also determined which services bring more value: the conventional paper-based services, digitalized e-service, or digitalized services after implemented digital transformation processes? In the evaluation process, the following parameters are taken into account:

- petrol and parking fees savings when collecting documents needed for submission in order to exercise a corresponding insurance proper privilege, and also costs for issuing these documents
- material costs savings
- time's valorization spent for administration

To exercise the right to orthopedic and medical aid, the insured person must first visit the appropriate doctor who will prescribe the aid and then attend the Fund branches to verify the certificate. After verifying the certificate, the insured person goes to the orthopedic company or pharmacy (for various orthopedic and medical aids) to pick up the aid or place an order for its production.

Healthcare Fund Annual Report [25] shows an increase the total number of certified orthopedic and medical aids in the recent years. So for the 2020 year that number reached 209.816 certifications. It means 233.278 visits per year in the Fund's branch offices, the same number of visits in orthopedic companies/pharmacies, and the same number of visits to a doctor. Suppose we assume that one such visit to a doctor or a Fund's brunch or a corresponding orthopedic company/pharmacy requires an average cost of 1.5 euros for petrol and parking. In that case, the possible direct savings of the

insured people are about 1.050.000 euro (3 x 233.278 x 1.5 euro) per year, only on petrol and parking.

Insured patients must visit a doctor for an examination and then a corresponding orthopedic company or pharmacy to get the aids. However, they do not need to present themselves to the branch offices of the Fund for the verification of certificates. It is made possible by the process of digitally signing the certificates for orthopedic and medical aids. On the other hand, it opens a possibility for saving one-third of the aforementioned financial resources. These savings would be even bigger if we consider that some orthopedic and medical aids require a conciliatory opinion from a medical commission, which increases the number of necessary visits and thus increases the implied cost correspondingly. Assuming that the doctors and employees of the Fund have qualified certificates for other purposes, the insured persons do not possess and do not have to possess qualified certificates on the token. Such possession would mean additional funds for their purchase.

The savings above (and much more) will be enabled after the future implementation of DT. Previously implemented digitization process and the proposed future DT, offer to the insured people and orthopedic companies saving in time and money. Also, the Healthcare Fund and orthopedic companies will make savings in the form of paper and printing expenses, labor etc. The savings will be made due to the elimination of the paper administrative documents, which exchanged between the Healthcare Fund and the other institutions (healthcare institutions, orthopedic companies) and discarding procurement of own qualified certificates.

Instead of purchasing qualified certificates on a token (by insured people and employees of orthopedic companies), the certificates will be provided by the Fund in the form of short-lived certificates.

Some additional advantages to the proposed solution that result from the implemented process of digital transformation described in this paper are the following:

- Increases security, visibility, process efficiency, Authenticity, and Integrity
- Documents are digitally signed and legally binding
- Time and cost reduce for provisioning, administration and management of users and tokens
- Cut paper-related costs for printing, scanning, searching for paper documents, and archiving

6 Conclusion

The paper's goal is to study and analyze the DT's effect on the quality of services impact for specific categories of citizens. We have described the potential advantages resulting from the DT process on the services of verification and issuing orthopedic and medical aids.

The benefits of DT process when applied to two services (verification and issuing of orthopedic and medical aids) are evaluated. For example, we have calculated simple one-year savings after the expected implementation of the DT in the future. However, we believe that the benefits are multilevel, going much beyond that given example.

The analysis presented in this paper shows that the DT of services and processes in the Healthcare Fund would positively impact the citizens (insured people) when exercising their healthcare rights. It will also positively impact on orthopaedic companies during compliance their administrative obligations within the whole process. A few potential benefits of DT in the services presented in this paper can be summarized. Orthopaedic companies and Healthcare Fund will have smaller material costs because of the reducing number of printed documents to the citizens. Providing streamlined and efficient e-services will enable faster and more accurate data access and better performance of services for certain specific categories of citizens. Citizens will save time to exercise the right to healthcare (by not presenting in person), which will also reduce transportation costs. Last but not least, the reduction of the numerous printed papers contributes by a positive impact to ecology, providing a greener society for all.

DT of the healthcare services comes not just with the implementation of new innovative technologies, but Healthcare Fund and orthopedic companies are also allowed to improve current processes which will influence to increase the quality of provided healthcare services.

Nevertheless, the effects of DT are long-term and their evaluation is a long-standing activity as in research so in practice.

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