

Digital platforms as a key factor of the medical organizations activities development

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Abstract. The subject of analysis in this article is digital platforms as a key driver of medical organizations sustainable development in the modern world. The research purpose is to consider the main components of the digital platforms using examples of works by different authors and to formulate the platform author's definition. On the basis of scientific works and periodical literature, an analysis of the digital services architecture used in the healthcare digital platforms implementation is carried out. The main regularities have been identified that influence the dynamics of transaction costs that inevitably arise as a result of communications in the socio-economic mechanisms of the digital economy. The key indicators analysis of digital solutions implementation level in the healthcare systems of such states as the USA, China, Germany, Singapore, Holland and the Russian Federation is carried out. Successful implementations examples of digital platform solutions by both foreign and Russian companies are considered. As an analysis result key advantages and achieved effects were formulated, both for patients and for medical institutions. This is due to the formation of new platform business models of the networked economy, the core of which is digital platforms and an ecosystem approach.

Keywords: Digital Business Model, Transaction Costs, Medical Digital Platform, Healthcare System Digital Transformation.

1 Introduction

Against the background of a slowdown in global economic growth [1], the sustainable development success of both public and private organizations in leading world countries largely depends on innovative IT solutions [2, 3] and business models that they use. Research in this area [4, 5] shows that only the introduction of breakthrough solutions, both in the management and in the digital transformation field, can give a powerful impetus to development. One of the most relevant areas of business development

is the digital business models development, the main element of which is digital business platforms [6].

As a result of the economy development, at the turn of the XX-XXI centuries, new approaches to organizing business interactions began to form. It could not affect the development of new business models. Thus, in one of the scientific works of Jean-Charles Rocher and Jean Tyrol, entitled "Competition of platforms in bilateral markets" [7], a new platform business model was described.

In 2018, the leadership of South Korea approved the national Program of Innovation Platforms [8] aimed at the platform economy development. The platform economy is understood as an ecosystem and infrastructure for promising industries, among which are: four areas of innovation policy in social systems, science and technology, human resource development, industry innovation; three strategic investment areas: blockchain-based data economy, artificial intelligence and hydrogen economy; eight leading sectors: smart factory, smart farm, smart city, transport of the future, fintech, new energy, biomedicine, drones.

The Decrees of the President of the Russian Federation "On national goals and strategic objectives for the development of the Russian Federation for the period up to 2024" and "On the national goals for the development of the Russian Federation for the period up to 2030" formulated tasks to ensure the accelerated introduction of digital technologies in the economy and social sphere. To solve this problem, the Government of the Russian Federation in 2019 formed and approved the national program "Digital Economy of the Russian Federation". The program determines the formation of platforms in various sectors of the economy as one of the key elements of its development [9].

In the Decrees of the President of the Russian Federation "On national goals and strategic objectives for the development of the Russian Federation for the period up to 2024" and "On the national development goals of the Russian Federation for the period up to 2030", one of the aim announced solving the problem of ensuring the accelerated introduction of digital technologies in the economy and social sphere. The Government of the Russian Federation, formed and approved the national program Digital Economy of the Russian Federation in 2019, which defines one of the key elements of its development as formation of platforms in various sectors of the economy [9].

At the same time, despite the global trend in the platform economy development and a fairly large number of publications on the topic of platform solutions and platforms, there is no common understanding of a definition as a "digital platform" in the scientific literature.

2 Materials and Methods

2.1 Research methods

The methodology for this study is a combination of the following steps:

1. Analysis. As part of the study, information was collected and analyzed on the existing definitions of the concept of "platform", "digital platform". Then, an analysis

was made of the possibilities of reducing transaction costs when using digital platforms. The analysis of the structure of transaction costs in the medical industry is carried out. The main services of digital platforms that have an impact on reducing transaction costs in healthcare are highlighted

2. Generalization. Based on the analysis of the literature, the authors generalized the experience of previous studies and proposed the author's definition of the concept of "digital platform". In a generalized form, the structure of services of digital platforms that have an impact on reducing transaction costs in healthcare is presented.

2.2 Approaches review to the "platform" and "digital platform" concepts formation

The Center for Digital Transformation Training Leaders of the Russian Academy of National Economy and Public Administration under the President of the Russian Federation (RANEPA) gives the following definitions to the concepts of platform and digital platform [10]. The platform is about products and services that bring together two groups of users in two-way markets. It is important to note that by two-way markets, the authors mean network markets that have two groups of users with the emergence of network effects between them. In a two-way network, there are two categories of its users, for which the purposes of using the network and their roles in the network are clearly different.

A digital platform is a system of algorithmized relationships between a significant number of market participants, united by a single information environment, leading to a decrease in transaction costs due to the use of a digital technology package and changes in the division of labor.

This definition allows you to focus on the key business aspects, however, it does not fully reflect the aspects related to the development of business relationships based on the digital platform development.

The study [11] considered and analyzed the following types of digital platforms:

- platforms for conducting scientific activities;
- professional social networks as platforms;
- aggregator platforms that combine large amounts of scientific data;
- platform-integrators, accumulating resources for scientific activities;
- crowdsourcing and gaming platforms.

The authors of the article [11] argue that the transformation processes taking place in the scientific world change the very approaches to the process of obtaining, distributing and analyzing knowledge. Knowledge is now being formed not only in research centers, but can also arise in the so-called centers of attraction. This allows you to consolidate close ties between meeting participants, which can also happen through platform solutions.

Despite the clear advantages of digital platforms in terms of building new communications between community members based on the openness and accessibility principles, it must be remembered that effective work is impossible without face-to-face

meetings (events). Thus, the organization of interaction between members of different groups should be built not only with the use of digital services, but also take into account the social essence of interaction in an offline format.

Following these statements, we will formulate the key aspects of the platform solution term.

First of all, the platform solution is based on the massive nature of the involvement of its participants, thereby forming new communities. Thanks to this, new communications are being built and the exchange of data between them increases. However, exclusively digital platforms create the effect of accelerating communications, destroying the principle of territorial distribution of community members, significantly reducing transaction costs in the form of time, searching and establishing new connections with the required community members [12].

In the study [13], the idea is expressed that platform business is the future of the world economy. Ecosystems formed on the basis of platform solutions are a factor of economic growth, undermining the positions of companies based on traditional business models.

It is important to understand that the platform itself is not a source of value for the interacting parties of its participants. The platform does not produce any material products, but acts only as a coordinator and database for its participants. At the same time, with the help of the platform tools, a large number of new communications between community members are generated. Based on this, a network effect arises: the more involved parties interact through the platform, the more valuable it becomes for its participants. Thus, the digital platform turns data into a key ecosystem asset of its participants.

An important task of any platform is to provide convenient, ideally customized, interaction tools for its participants. The continuous process of optimization and operational management of all business processes within the platform is a strategic task in the platform solutions implementation.

From the point of view of [14], a platform is a new type of firm based on a digital infrastructure that allows two or more groups to interact. Nick Srnichek from King's College London in his work "Platform Capitalism" refers to the main characteristics of the platform: emerging network effects, lack of need for its own infrastructure, the formation of the platform architecture, which includes the interaction of various community members. He also distinguishes five types of platforms:

- advertising platforms (Google, Facebook): generate profit through in-depth analysis of data on user behavior, selling advertising space;
- cloud platforms (AWS, Salesforce): provide their computing power and software products for rent;
- industrial platforms (General Electric, Siemens): produce modern digital equipment and software in order to transfer industrial production to digital products and services, thereby significantly reducing their costs, turning their goods into services;
- grocery platforms (Rolls Royce, Spotify): use third-party platforms, embedding them in their own products and offering them already as a service;

- lean platforms (Uber, Airbnb): minimize the volume of their own assets, gaining by maximizing cost savings.

In his article "Problems of research on multilateral platforms" A.I. Kovalenko. [15] considers such a concept as a multilateral platform. The authors define a multilateral platform as a complex of devices and programs, an objective digital space for a trading platform. The authors of the article believe that at the heart of any platform should be something attractive to the end user, the value that was either absent earlier or contained significant costs.

The authors see the following components as distinctive features of multilateral platforms: a special type of the company's business model, direct and indirect network effects [16], a technology standard, which is a set of specifications that ensures compatibility of software and hardware, a special type of strategy associated with platform thinking. Also, the authors, referring to the report of the Center for Global Entrepreneurship, describe a general typology of multilateral platforms, according to which four categories are distinguished: transactional (VISA, SWIFT), innovative, integrated (Apple) and investment (Softbank, Priceline Group, Naspers, IAC Interactive, Rocket Internet).

Salienko N.V. and Konopatova S.N. in the work "Analysis of business models based on platforms" [17] consider an example of the first economic ecosystem that appeared in the 19th century, represented by a telephone network, for which an analog switch acted as a one-way platform. The network effect from the implementation of this ecosystem was obvious and consisted in an increase in the number of subscribers, which in turn formed a special value for its participants. The article also analyzes ecosystems based on two-way platforms. Characterizing these types of platforms, the authors highlight their common features: the eco-system effect, when the value of the platform grows without the efforts of the platform holder; the ease of market entry for community members, and a developed network effect.

Considering the platforms, one cannot fail to note the work [18], where, according to the authors, the platform should ensure the interaction of four basic groups of players: producers, consumers, providers and platform owners.

Summarizing the formulations and main aspects of the digital platform concept considered in this work, it can be noted that in each of them, the basic components, in one form or another, are such components as: ecosystem, business model, a special type of firm and strategy, reduction of transaction costs, open and an accessible information environment, a communications accelerator, a system of mutually beneficial and algorithmic relations, communication groups, a "products and services" model, a system of rules, a set of software and hardware, a data aggregator. From the point of authors view, in defining a digital platform it is necessary to pay attention to aspects of the mutual business and digital platforms development.

3 Results

3.1 Digital Platform as a modern business model

Summarizing the experience of previous studies, we can say the following: the platform is the basic architecture of a special type of firm with a platform business model and development strategy, an open and accessible information environment, a system of rules aimed at forming new mutually beneficial and algorithmized relationships between groups, as a result of accelerating communications which form and aggregate new data, the transaction costs of business interaction are reduced.

Given the global platforming factor of the world economy, it is important to understand that the platform is built using a “products and services” model, which can later be scaled to the size of ecosystems using a set of software and hardware.

The formulated theses allow at the abstract level to highlight the main criteria for assigning various entities to the "platform" concept:

- the presence of a basic architecture of algorithmic communications between participants;
- mutual benefit, openness and accessibility of relations between the participants;
- network effect due to the massive nature of the involvement of participants;
- availability of a unified information environment for interaction;
- significant transaction costs reduction for participants.

Thus, correlating the above statements, we propose to treat the platform as a digital data-centric business model, covering a significant number of participants, providing an effective organization of algorithmic interaction, leading to a significant reduction in transaction costs of its participants.

Based on the analysis of existing approaches to the definition of digital platforms, the authors propose the following definition: a digital platform is a digital data-centric business model, covering a significant number of participants, providing an effective organization of algorithmic interaction, leading to a significant reduction in transaction costs of its participants.

Currently, digital platforms play one of the key roles in the management of various levels socio-economic systems in countries such as the USA, Germany, Japan, Great Britain, etc. They were joined by China, South Korea, Finland, Russia. Strategic development programs for these countries are based on the platform economy formation [9, 19, 20, 21]. The relevance of the development and use of digital platforms is largely due to the possibility of creating and developing eco-systems of business in various industries.

Due to their omnichannel and cross-functionality, ecosystems formed on the basis of digital platforms are able to offer their consumers cross-industry, seamless high-quality services in order to satisfy the personal needs of each participant in the ecosystem [21].

The digital platforms and services development has contributed to the successful integration of a customized approach in the provision of goods and services to all inter-

ested members of the formed community groups. In this regard, the healthcare system is an active participant in this market for personal medical services based on its own digital platforms [22, 23, 24].

The events of recent years, in particular the fight against the consequences of the coronavirus infection COVID-19 spread, have shown the need for the development of digital platforms in the medical field.

BigTech giants such as Google, Apple, Facebook, Amazon, Microsoft, as well as IBM, Alibaba and a number of other players in the IT industry have been key players in the healthcare ecosystem market for over 10 years. They are active in the research and development of digital platforms with the aim of providing high quality personalized medical services to an almost unlimited number of stakeholders.

Vivid examples of the implementation of such projects for the interaction of medical organizations with Amazon, Google Cloud, Salesforce and Microsoft Azure are joint technological solutions in the field of data management, as well as the provision of technological infrastructure for the provision of telemedicine services.

Among medical digital platforms, the following types are distinguished [25]:

- health care support platforms that provide access to treatment processes and medicines;
- unified platforms for virtual health care;
- multidisciplinary platforms providing primary health care services;
- integrated digital platforms providing telemedicine services in conjunction with offline service providers;
- platforms that implement health care management services.

Both for other states and for the Russian Federation, the transition to the provision of various services for citizens through a system of digital platforms in healthcare is an important issue for the sustainable development of this industry in modern realities. In the technological race for leadership in the provision of medical services for citizens, Russian scientific and research institutions, medical centers, investment funds, telecommunications companies and private innovation organizations play an important role in shaping the basic architectural landscape of the modern platform business model.

The most successful projects implemented in the Russian Federation in the creation and development of digital platforms in the medical field are the developments of Sberbank PJSC. It forms its own ecosystem based on the digital platform in the field of Digital Health. Skoltech and the Skolkovo Foundation are the forge of MedTech startups.

Another major player in the domestic digital medicine market is RT Medical Information Systems with its own technological solutions called "Single digital platform.LIS" and "Single digital platform.MIS", which offers a comprehensive solution.

With the help of data services of digital platforms, the following tasks can be solved:

- maintaining a patient's electronic medical record;
- managing the dispensing of preferential drugs;

- maintaining registers of patients with cardiovascular diseases, which is formed on the basis of taking into account specialized parameters;
- provision of telemedicine consultations;
- monitoring the health status of citizens with cancer;
- preventive medical care, providing citizens coverage by age and professional categories;
- patient flow management;
- pregnant women monitoring.

Considering the successful digital solutions presented on the healthcare market today, the following generalized directions for the development of services based on digital platforms are seen as follows:

- diseases prevention and healthy lifestyle formation;
- generalization and in-depth analysis of customer experience;
- clinical trials unified database;
- telemedicine;
- distance education;
- Internet navigation of citizens in the healthcare system.

3.2 Transaction Costs and Effectiveness of Digital Platforms Using

One of the key tasks solved with the digital platforms services is the problem of reducing transaction costs.

The approaches used today in working with digital data have a significant impact on the transaction costs size. Often, due to a significant reduction in transaction costs, it is possible to achieve large-scale network effects, both direct and indirect.

In general terms, transaction costs are understood as any costs of searching and processing information, negotiating, measuring various indicators of interaction, as well as compliance with the contractual relations fulfillment [26]. At the same time, there is no single definition on this score.

Transaction costs in the medical industry.

Let's take a closer look at the structure and elements that are attributed to transaction costs in the medical industry.

The constituent elements of the costs of searching and processing information include mainly the time and location costs of searching for relevant information, for example, the patient's medical history and monitoring of his condition, the clinical trials results, regulatory knowledge bases, etc.

The negotiating costs are primarily due to the representation costs of a financial nature, the costs of maintaining communications employees, their training, as well as the risks of the communications themselves between the subjects of the relationship.

The widespread use of end-to-end technologies, such as artificial intelligence, augmented and virtual reality, the Internet of Things, has made it possible to significantly reduce the time and money spent on negotiations. Various digital communication ser-

vices increase the speed and efficiency of negotiations. When using digital services, the time, cost and risks associated with the personal qualities of the negotiators are significantly reduced, and such a barrier as the location of the interacting parties is eliminated.

In the data-driven digital economy, measurement costs have become more relevant and are an important indicator of the various projects success. One of the drivers of a socio-economic relations new type is network decentralized communications exclusively in the digital environment. They provide ample opportunities for assessing and comparing the properties of various objects based on the opinion of a significant number of community members. This is actively promoted by such mechanisms as crowdsourcing and noo-sourcing, which are based on network technologies.

The main difference between these mechanisms is that crowdsourcing makes it possible to express their point of view on a particular problem to any interested person who is not part of the professional community in order to generate new ideas for its solution in an open form. No-sourcing is a professional tool that provides ample opportunities for conducting data-driven research directly with the participation of experts from various fields of knowledge. Based on the conclusions formed by experts, it is possible to prepare analytical materials for the implementation of global projects [27].

An important element of communication between the subjects of socio-economic relations is contractual relations and the associated corresponding costs of concluding transactions and compliance with their execution, as well as the costs of opportunistic behavior.

Digital platforms implement the use of seamless services from various market sectors, as well as the use of digital technologies (blockchain, artificial intelligence, big data, etc.). This made it possible to solve the difficult problem of mutual trust and control over the fulfillment of obligations assumed by the parties to the transaction, both on the part of a medical organization and on the part of an insurance company or a patient. As a result, concepts such as smart contracts and digital trust have emerged.

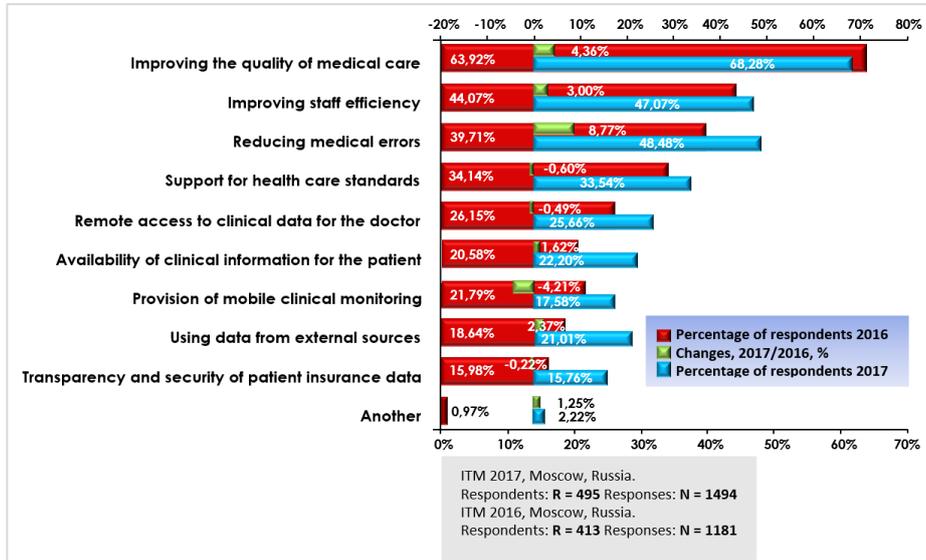


Fig. 1. The effect of the information systems introduction for a medical institution.

Digital healthcare platform solutions leverage end-to-end technologies to support faster, more cost-effective and efficient healthcare practices. They help improve the availability, quality and comfort of healthcare for people around the world, while eliminating routine tasks for healthcare personnel. This statement is confirmed by the research results reflected in the HealthNet Analytical Report of the National Technology Initiative for 2019 (Fig. 1).

The mutual benefits of platform communications within communities have shaped the massive network effects inherent in multilateral markets. An important circumstance of this effect is the fact that the satisfaction of the needs of some group members is not a consequence of the disappointment of others. Application of the “win-win” model in the platform economy shows that as a result of interaction there are winners and no losers [28].

The work [29] states that, based on the World Bank's research, the development of digital platforms should become one of the priority strategic directions for the formation and development of the digital space of the Eurasian Economic Union in the future until 2025.

The key indicators analysis of digital solutions implementation level in the healthcare systems.

According to the annual analytical reports The Future Health Index, commissioned by Philips since 2016 [30], it is possible to trace the path of the global transition to digital healthcare at a higher level, with a decreasing costs level, including transaction costs. Indicators reflecting the dynamics of the transition of the global healthcare system to a new digital ecosystem are presented below. The analysis of the digital transformation

processes of national health systems is considered on the example of the following countries: the USA, China, Germany, Singapore, Holland and the Russian Federation (Table 1).

Table 1. The Future Health Index.

Country	Future Health Index (points)	Country	Value Measure (points)
	2016 year		2018 year
Netherlands	58,9	Singapore	54,61
China	58,1	Germany	50,93
Singapore	57,7	Netherland	48,93
USA	57,4	Russia	40,90
Germany	54,5	China	38,11
Russia	42,4	USA	37,95

The range of measurement values for The Future Health Index, according to the assessment methodology [30], lies in the range from 0 to 100 points.

The Future Health Index (FHI) helps in an objective assessment of the strengths and weaknesses of the health care system for the country under study, based on the opinions of both health professionals and ordinary citizens, in three key areas: the health services availability, the health systems integration, the volume of digital technologies in the healthcare system.

Since 2018, The Future Health Index has been transformed into a more comprehensive indicator that reflects the values from the point of patient and medical staff view - Value Measure (VM). This indicator includes characteristics: the medical care availability, satisfaction with the medical care quality, the medical care effectiveness.

The availability of medical care is assessed by the following components: the number of qualified medical personnel per 10,000 citizens; the number of hospital beds per 10,000 citizens. When assessing satisfaction with the medical care quality, such components as trust in the health care system and its accessibility, perception of the medical care quality are taken into account. The health care delivery efficiency indicator includes health care expenditures as a percentage of a country's gross domestic product (GDP), life expectancy, neonatal and maternal mortality rates, and the likelihood of dying from major chronic diseases for citizens aged 30 to 70 years. Also, like The Future Health Index of 2016, the range of VM measurement is in the range from 0 to 100 points.

At the same time, a study carried out [30] in 2019, aimed at assessing the indicator of the use of digital technologies in healthcare, showed that China is a leader in this area (the indicator 94%). The indicators of other countries have the following meanings: Holland - 86%, Singapore - 82%, Russian Federation - 81%, United States of America - 76%, Germany - 64%. The indicator's value is based on a survey of medical staff who use various digital solutions in their professional activities, such as digital medical records of patients, telemedicine technologies, etc.

Based on data from the World Health Organization, the United Nations and the World Bank, analysts from the Bloom-berg agency are forming the Healthcare Effi-

ciency Index. This index is based on three key indicators that assess the effectiveness of the state health care system [31]:

- average life expectancy with a weighting factor of 60%;
- government spending on health as a percentage of GDP per capita with a weighting factor of 30%;
- the medical services cost per capita with a weighting factor of 10%.

Healthcare Efficiency Index data for 2016 and 2018 are presented in Table 2.

Table 2. Healthcare Efficiency Index.

Country	Healthcare Efficiency Index (points)	Country	Healthcare Efficiency Index (points)
	2016 year		2018 year
Singapore	84,20	Singapore	85,60
China	54,30	China	54,60
Netherlands	48,30	Netherlands	50,80
Germany	42,60	Germany	38,30
USA	32,60	Russia	31,30
Russia	24,30	USA	29,60

The range of measurement values for this indicator is in the range from 0 to 100 points. The highest value of this index indicates the maximum efficiency of the assessed health care system.

The University of California Davis reported that between 1996 and 2013, telemedicine services, information systems and digital platforms saved patients \$ 2.9 million in travel costs and 9 years of time they could have. spend on travel to healthcare facilities [33].

According to [34], Mayo Clinic and Google signed an agreement to develop a telecommunications giant based on digital platforms, cloud computing methods, data analysis, deep learning and the use of artificial intelligence to solve the most complex medical problems. Digital platforms transform the way patient care is provided, provide proactive services to citizens, provide patients with online and offline on-demand services, reducing transaction costs for information retrieval and processing, negotiation and measurement of various interaction indicators. Thus, digital platforms allow realizing a new paradigm of the healthcare system based on value-based medicine [35].

Digital platforms services impact on reducing transaction costs in healthcare.

Based on the experience of the studies reviewed, we propose a generalized structure of digital platform services that have an impact on reducing transaction costs in healthcare (Table 3).

Table 3. Generalized structure of digital platforms services that have an impact on reducing transaction costs in healthcare.

The service name that reduces costs	Transaction cost type					
	search and processing of information	negotiation, communication	Interaction metrics measurements	transactions	opportunistic behavior	specification and protection of intellectual property rights
Automatic filling of medical documents	+		+		+	
Voice input when filling out documents	+				+	
Integration with external services	+	+		+		+
Marketing services	+		+	+		
Mobile application for doctors and patients	+	+			+	
Educational and research services	+	+				+
Online interaction with external organizations and structures	+	+		+	+	+
Online reporting	+		+		+	
Information and reference system services	+	+				
Drug supply services	+			+		
Emergency services		+			+	
Services of state funds and organizations	+					

The service name that reduces costs	Transaction cost type					
	search and processing of information	negotiation, communication	Interaction metrics measurements	transactions	opportunistic behavior	specification and protection of intellectual property rights
Decision support system	+				+	
Medical resource management	+	+	+	+	+	+
Financial and insurance services	+	+		+		
Electronic document management	+		+	+	+	+

Taking into account the elements of transaction costs and factors influencing their behavior, we will give a definition of this concept.

By transaction costs in health care we mean the costs of any content and possible risks of interaction between subjects, expressed in economic terms, which inevitably arise between equal participants in socio-economic relations in the digital economy in the implementation of communications.

The data on the level of the digital solutions implementation in the national healthcare systems of the considered countries confirm the success of the medical digital platforms implementation in terms of solving urgent problems of the networked economy by continuously reducing transaction costs, simplifying data exchange processes, performing various operations, and forming communications.

4 Discussion

As a result of the study, the "digital platform" concept was clarified, the question of the transaction costs structure in the medical industry was considered. It is shown how the use of digital platforms in healthcare provides a reduction in transaction costs. A generalized structure of digital platform services is proposed. The question of the digital platform services influence possibility on the transaction costs reduction in healthcare is considered. In the future, we plan to consider the issues of improving the medical organization management based on a digital platform.

5 Conclusions

The process of changing healthcare systems is large-scale and complex. The core of the ongoing changes are digital platforms that change not only business models, but have a significant impact on reducing transaction costs, while ensuring the digital services development for citizens and businesses, allowing efficient search for relevant information, increasing the speed and efficiency of negotiations and conclusion deals, acting as a powerful driver for the development of the Digital Health concept.

In the context of global transformation processes of the world economy, when the level of transaction costs has a significant impact on the success of projects being implemented, the transition to platform models of public healthcare systems is a guarantor of sustainable development of this economy sector.

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