

Ministry of Education and Science of Ukraine
Black Sea Universities Network

ODESA NATIONAL UNIVERSITY OF TECHNOLOGY

International Competition of
Student Scientific Works

BLACK SEA SCIENCE 2022 PROCEEDINGS



ODESA, ONUT 2022

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BLACK SEA SCIENCE 2022

Proceedings

Odesa, ONUT 2022

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INTRODUCTION

International Competition of Student Scientific Works “Black Sea Science” has been held annually since 2018 at the initiative of Odesa National University of Technology (formerly Odesa National Academy of Food Technologies) with the support of the Ministry of Education and Science of Ukraine. It has been supported by Black Sea Universities Network (the Association of 110 higher education institutions from 12 countries of the Black Sea Region) since 2019, and by Iseki-FOOD Association (European Integrating Food Science and Engineering Knowledge into the Food Chain Association) since 2020.

The goal of the competition is to expand international relations and attract students to research activities. It is held in the following fields:

- Food science and technologies
- Economics and administration
- Information technologies, automation and robotics
- Power engineering and energy efficiency
- Ecology and environmental protection

The jury includes both Ukrainian and foreign scientists. In the 4 years that the competition has been held, the jury included scientists from universities of 24 countries: Angola, Azerbaijan, Benin, Bulgaria, China, Czech Republic, France, Georgia, Germany, Greece, Israel, Italy, Kazakhstan, Latvia, Lithuania, Moldova, Pakistan, Poland, Romania, Serbia, Slovakia, Switzerland, Turkey, USA.

At the same time, every year the geography has expanded and the number of foreign jury members has increased: from 46 jury members representing 25 universities from 12 countries in 2018, to 73 jury members of the 46 universities from 19 countries in 2022.

More than a thousand student research papers have been submitted to the competition from both Ukrainian and foreign institutions from 25 countries: China, Poland, Mexico, USA, France, Greece, Germany, Canada, Costa Rica, Brazil, India, Pakistan, Israel, Macedonia, Lithuania, Latvia, Slovakia, Romania, Kyrgyzstan, Kazakhstan, Bulgaria, Moldova, Georgia, Turkey, Serbia.

The interest of foreign students in the competition grew every year. In 2018, the students representing 15 institutions from 7 countries have submitted 33 works. In 2021 the number of submitted works increased to 73, authored by the students of 40 institutions from 18 countries.

The competition is held in two stages. In the first stage, student research papers are reviewed by members of the jury who are experts in the relevant fields. In the second stage of the competition, the winners of the first stage have the opportunity to present their work to a wide audience in person or online.

All participants of the competition and their scientific supervisors are awarded appropriate certificates, and the scientific works of the winners are included in the electronic proceedings of the competition. Every year the competition receives a large number of positive responses from Ukrainian and foreign colleagues with the desire to participate in the coming years.

2. ECONOMICS AND **ADMINISTRATION**

MAIN TRENDS OF DIGITALIZATION DEVELOPMENT IN UKRAINE AND DIRECTIONS OF THEIR IMPROVEMENTS

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Abstract. *Today digitalization of Ukraine's economy is one of the most promising and relevant areas, which requires much attention, as well as new approaches to its implementation, research and reform. The whole world, including Ukraine, is undergoing a process of digital transformation and adaptation. It affects all areas of our lives, from education to the economy. Digitalization is a complex system that is interconnecting by interdependent factors that are vital to each other.*

At present, few studies have examined the state and level of digitalization of Ukraine's economy. Thus, there is a need to improve the mechanism and tools for the development of digitalization to achieve a high level, which led to the choice of research topic, its purpose, objectives and content.

The purpose of scientific work is to analyze the level of digital transformation of Ukraine and the world, development of methodological and scientific-practical recommendations for improving the mechanism of digitalization of the economy.

Keywords: *digital transformation, information technology, digitalization, digital economy, digital infrastructure, network effect, digital organization, blockchain technologies.*

I. INTRODUCTION

The world economy has changed over the last ten years to such an extent and at a rate faster than ever before. Europe, North America, Asia are literally digitizing their economies, waiting for the global impact of advanced technologies to increase with increasing profits from e-commerce, data exchange and services. The realities of the global world dictate the following conditions for modernizing the economy and creating clear rules for a new era of innovation. The adaptation and transformation of business, education, health and public services through digital technologies is a major obstacle to solving global problems. Information technology allows any company to change its own business model to be competitive in the global market. Digital transformation itself is a catalyst for innovation and change in all spheres of life.

Given the urgency of this problem, the paper considers the main obstacles and drivers of digitalization transformation in Ukraine. External and internal preconditions and future challenges conditioned by digital transformation are analyzing.

II. LITERATURE ANALYSIS

2.1. Theoretical fundamentals of the process of transformation and digitalization of economic processes of the country

According to statistics, almost half of the world's population is an active user of the Internet. That is why now studying the world or doing business using new

technologies is not a trend, but a daily necessity. The digital transformation, or digitalization, has integrated into all aspects of society, including business, government, health care, the media, science, and so on. With the development of digital technologies, the term "digitalization" has become widely used.

Table 1. The main meanings of the term «digitalization»

№	Author	Meaning	Resource
1	Claude Shannon	Digitalization is the process of converting data, often tangible, into digital format that can read from a computer screen or smartphone. [1]	«Mathematical Theory of Communication», 1948
2		Digitalization is the use of digital technologies to change the business model and provide new opportunities for revenue and value creation; it is the process of transition to digital business. [2]	Gartner's Dictionary
3	Team «TruQC»	Conversion of data, documents and processes into digital analogues. [3]	Website «TruQC»
4	Margaret Rose	Margaret Rose Digitalization is the process of converting information into digital format. [4]	Website «WhatIs.com»
5		Digitalization is most often understood as the creation of opportunities, improvement and / or transformation of business operations and / or business functions / or business models / processes / or activities through the use of digital technologies and wider use and context of digitized data converted into intelligence and practical knowledge. [5]	Website i-SCOOP

So if we summarize the above meaning, we can say that digitalization is the conversion of data, documents and processes into digital format, through the use of digital technologies to provide new opportunities. Automation, optimization, process autonomy, as well as great flexibility and individuality of products and services - these are just some of the benefits and opportunities of digitalization.

Digital technologies are at the heart of an increasing number of transactions, and the digital economy is becoming increasingly integral to the functioning of the economy as a whole. Different technologies and economic aspects of the digital economy can divide into three main components (Figure 1).

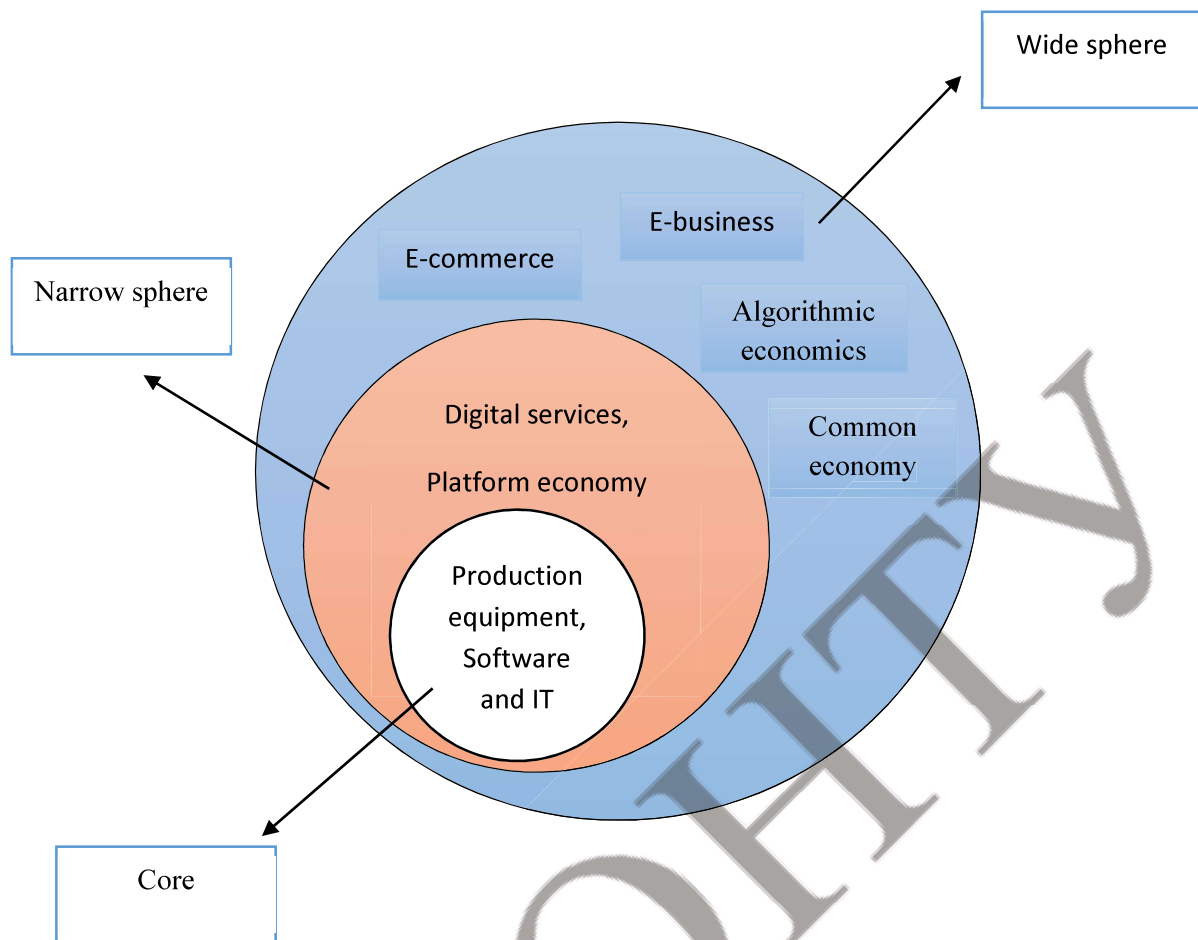


Figure 1. The main components of the digital economy

In order to make the digital transformation successful, the company must have the necessary prerequisites. There are three stages in the transition to digital organization (see table 2).

Table 2. Stages of the transition to digital organization

Evolution	Revolution	Digital part
The evolutionary change of the company to a digital organization. The phases of evolution are getting smaller, but the process is very slow.	Sharp restructuring of the organization. The process is faster than at the stage of evolution.	Separation of a digital division or its separation into a separate organizational unit, such as a subsidiary.

The main feature of the digital economy is that the key position is occupied by the process of increasing productivity: the more customers in the company, the more «productive» it is, and it follows that it is able to offer better services at the same price, which encourages new customers. This phenomenon is associated with network effects: the quality of service depends on the size of the network, ie the number of users. [6]

The increase in the number of enterprises with a network effect in the digital economy is due to lower transaction costs: digital technologies simplify the process of authenticating the other party and obtaining information about its reputation. In other

words, they facilitate communication and monitor the implementation of agreements and promote trust between parties who do not know each other. This has led to the emergence of huge platforms on which every entrepreneur, and not only, can find customers in optimal and safe conditions and provide them with services, the quality of which is sometimes higher than in traditional professions. [7]

When it comes to authentication of parties and transactions between them, you need to pay attention to Blockchain technologies. Blockchain technologies are a form of distributed registry technology that allows multiple parties to participate in secure, trusted transactions without an intermediary.

Digital markets are full of competition. In the digital economy, company monopolies are less stable than in traditional business networks. In the short time of the digital economy, temporarily dominant companies have been pushed out of their positions by subversive innovations or the emergence of more innovative competitors. The web browser market has been dominated by Netscape, Internet Explorer and Google Chrome. Although Google supplanted the first generation of search engines and became the second largest market capitalization in the world. The fragility of the positions won is due to particularly fierce competition. The cost of launching a product or service is very low: most digital markets require little physical capital to enter. Constant pressure from new entrants: the cost of starting startups has risen sharply over the last ten years, and their growth is increasingly financing by venture funds. Competitors of a dominant company can regain the initiative at any time and challenge its monopoly by rapidly expanding new processes or functions on a large scale. Finally, large digital companies are competing with each other, constantly diversifying into new markets to benefit from synergies and make it harder to combat their dominance. [8]

The instability of dominant positions can also explain by dependence on users. In traditional services, network effects arise due to infrastructure that requires high financial costs. In the digital economy, these effects are not relating to material infrastructures, but to the trust instilled in users: a single high-quality «experience» convinces them not to consider the proposals of other digital companies in the same direction. However, in the digital economy, where «competition is at arm's length», people are becoming more demanding. The Internet increases competition by reducing the cost of research and price comparisons. Consumers are constantly approaching by newcomers to the market. They communicate with each other, coordinate their actions and now form a huge mass, able to quickly compete with each other from the available proposals. With this situation, as in the past, digital companies can only gain a foothold in the material component and earned capital and regulatory barriers. They must constantly innovate and implement innovations to improve the product intended for the user. [9]

There are two types of network effect in the digital economy:

1. Direct network effect

Direct network effects occur when each user of the network benefits and enjoys connecting other users of the "same type" to the network. The example of the telephone shows that the benefits that the subscriber receives from the service increase with the number of other people who can connect. The dynamics of network effects depend on the fact that a permanent user base encourages potential users who are not yet

connected, and on the fact that each new user increases the satisfaction of users already present in the network.

2. Indirect network effect

Indirect network effects occur when multiple categories of users interact on platforms, linking multiple types of participants, such as multiple buyers and multiple vendors (as opposed to the traditional single vendor model and large number of buyers). In this structure, called the "bilateral" or "multilateral market", customer satisfaction on one side of the market increases with the number of users on the other side.

2.2. Analysis of the level of digitalization of the economy in the world

The business community and governments of the world, including Ukraine, are aware of the need to accelerate the process of digitalization and digital transformation of the economy in order to achieve competitive positions in the digital space of the new world economy. The digital economy sets the vector according to which the socio-economic systems of micro and macro levels will develop in the long term and calls for research and comprehensive analysis of digital transformation processes. Today, digital transformation has become a mass phenomenon, and relevant projects are vital to the success not only of individual companies, but also of individual regions and countries.

The analysis of Ukrainian and foreign practice, as well as theoretical research is carrying out on several indicators (see Table 3.). [11]

Table 3. The main criteria for the level of digital transformation of the world economy

№	Criteria	Value of the criteria
1	Broadband	Fixed broadband transmission
2	Use of the Internet	Use of the Internet by citizens
3	Human capital	Internet Skills
4	E-commerce	The level of digitalization of business and digital commerce
5	Digitalization of public services and services	Level of e-government

In the period of globalization and development of new technologies, the Internet occupies an important place in public life. Most new technologies depend on the availability of Internet resources and related services. Connecting to the Internet allows you to develop the potential and competitiveness of the state in the digital world. Very fast connection to the Internet called broadband access. Therefore, most countries are working to provide their citizens with quality broadband. To date, there is no single approach to the definition of «broadband».

Over the past few years, e-commerce has become an integral part of the global retail and wholesale system. As in many other industries, the market has undergone significant changes since the advent of the Internet, and thanks to the long digitalization of modern life, consumers from almost all countries now benefit from online transactions.

The Asia-Pacific region and North America lead the regional e-commerce retailers. The Asian region accounts for 42% of worldwide retail sales, North America 22% and Europe 16%.

UNCTAD estimates that the global value of e-commerce (B2B and B2C) sales reached nearly \$ 25 trillion in 2018, which is 30% of GDP and an increase of 8% compared to 2017 (\$ 23.8 trillion) (see Table 4).

Today, the success of e-commerce can be assessed by several parameters:

- Level of logistics;
- Average income per buyer;
- Market income;
- Percentage of the population shopping online;
- Number of online buyers;
- Percentage of buyers from abroad;
- Number of buyers from abroad.

Table 4. Analysis of profits from e-commerce in the world

Rating	Country	Sales volume (\$ billion)	Percentage of e-sales in the country's GDP (%)	B2B sales (\$ billion)	B2C sales (\$ billion)
1	USA	8,640	42%	7,542	1,098
2	Japan	3,280	66%	3,117	163
3	China	2,304	17%	943	1,361
4	Republic of Korea	1,364	84%	1,263	102
5	UK	918	32%	652	266
6	France	807	29%	687	121
7	Germany	722	18%	620	101
8	Italy	394	19%	362	32
9	Australia	348	24%	326	21
10	Spain	333	23%	261	72
	Sum	19,110	35%	15,772	3,338
	In the world	25,648	30%	21,258	4,390

Data from 2020 show that many more countries and municipalities are pursuing digital government strategies, some of which are radically different from those guided by previous e-government initiatives. Some of the new approaches used by Governments for digital transformation include e-government as a platform, integration of interactive and autonomous multichannel delivery, flexible development of digital services (supported by the whole government and society), expanding e-participation and partnerships, approaches, strengthening the digital capacity to provide people-oriented services, and the innovative use of new technologies such as artificial intelligence and blockchain (especially in the development of «smart city»).

Although there is usually a positive correlation between the ranking of e-government development and the level of income of the country, financial resources are not the only decisive factor in the development of e-government. Too often, strong political will, strategic leadership and a commitment to integrating digital services will allow a country to achieve a higher level of development than we might expect.

Significantly improved the provision of digital public services; today, more than 84% of countries offer at least one online transaction. The most common digital services offered worldwide are registering a new business, applying for a business license, obtaining a birth certificate, paying for utilities, and more.

All regions are making progress in e-government development, as evidenced by their higher e-government development averages (see Figure 2).

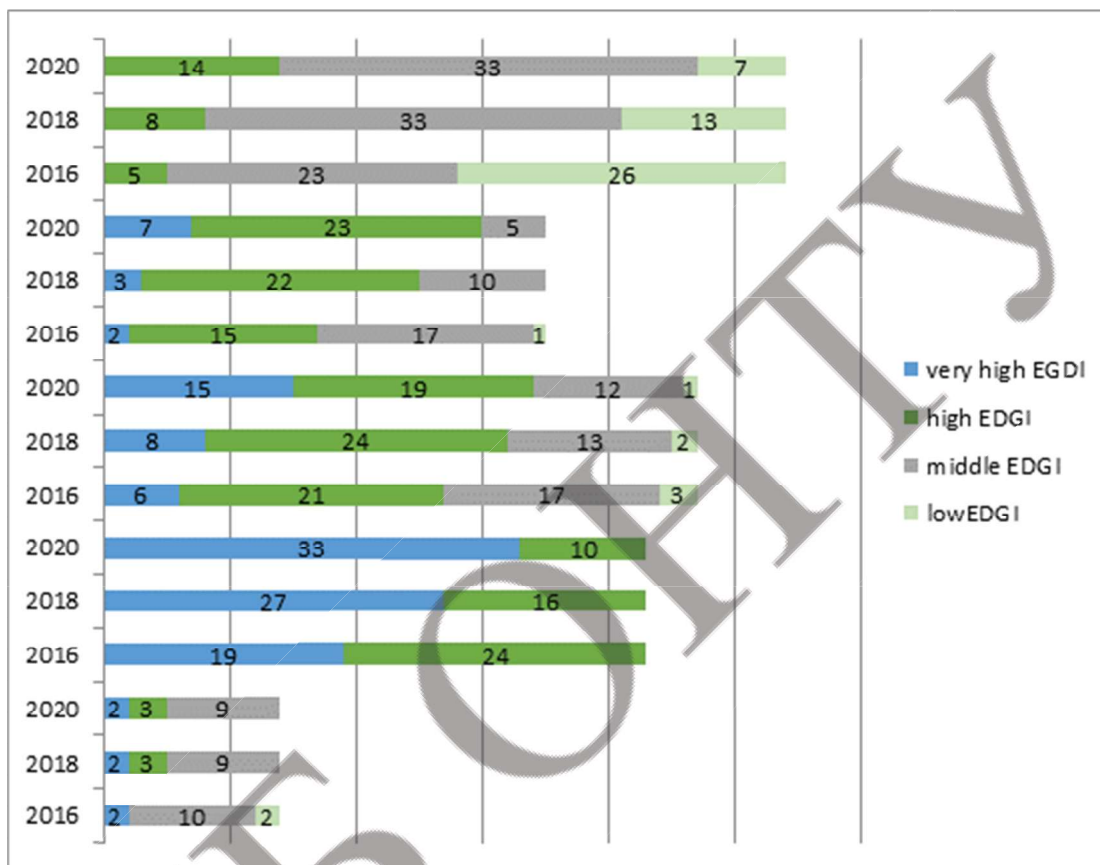


Figure 2. The level of electronic services in the regions

The leader remains Europe with the highest share of countries with a very high level of development (58%), followed by Asia (26%), America (12%) and Oceania (4%).

III. OBJECT, SUBJECT, AND METHODS OF RESEARCH

The object of research is the digitalization of the economy of Ukraine and other countries in the world.

The subject of the research is the main trends in the development of digitalization in Ukraine and the directions of their development.

In the process of research, general scientific methods were used:

Methods of dialectical cognition (abstraction, historical and logical unity) revealed the essence of the process of digitalization, the main directions and problems;

Through the descriptive-inductive and analytical method, the main points of digitalization of Ukraine were considered and identified. Reforms were proposed to improve the management mechanism for the development of this process and scientific and methodological approach to the organization of its management.

IV. RESULTS

In recent years, mobile (mobile) operators have significantly expanded their coverage of 4G networks in Ukraine, which has increased to 78% of the population that can receive mobile broadband Internet access.

In turn, the expansion of 4G coverage and the widespread use of consumer end-to-end equipment operating on operating systems (smartphones, tablets) have led to an increase in the consumption of mobile Internet traffic.

In addition, there is a gradual increase in the number of consumers of machine-to-machine (M2M) and Internet of Things (IoT) services.

71% of Ukrainians (22.96 million) regularly use the Internet. This stated in the research of the Research Holding Factum Group Ukraine.

According to the dynamics of Internet penetration, in 2020 71% of Ukrainians used the Internet once a month or more often, which is 8% more than in the previous year (63% see Figure 2.2).

According to the study, in cities with a population of more than 100 thousand, Internet penetration - 42%, in areas with a population of less than 100 thousand - 29%, in rural areas the same figures - 29%.

The study shows that women are more likely to use the Internet - 52%, men - 47%.

The largest number of network users is in the Central-Northern regions of Ukraine (33%), in the East - 29%, in the Western regions - 27%. The south of the country reached 11%.

A large number of users among people aged 25-34 (25%). The second place to use the network is the population aged 35 to 44 years - 21%, 18% - people aged 45 to 54 years, adolescents and young people aged 15 to 24 years are only 15%, and 12% - people aged 55 up to 64 years and 8% of persons over 65 years.

In December 2020, the first results of the all-Ukrainian study of digital literacy of Ukrainians were obtained. It was based on the methodology used by the European Commission to calculate the Digital Economy and Society Index. This index consists of the following indicators: Internet connection, human capital, Internet use, digital integration, digital government services. The results showed that - 53% of the population of Ukraine (according to the methodology of digital skills assessment used by the European Commission) are below the "base level".

If you break down this figure in more detail, you can see the following:

- 37.9% of Ukrainians aged 18-70 have digital skills below the basic level;
- 15.1% do not own them at all.

If we analyze the growth rate of e-commerce in Ukraine, they have recently significantly exceeded the growth rate in Europe, which is primarily due to the sharp increase in Internet penetration in Ukraine. Unfortunately, this trend will not continue for more than 2 years, as the growth rate of Internet penetration decreases as its absolute value increases, which in turn significantly affects the dynamics of Internet trade (see Table 5).

Table 5. Dynamics of e-commerce development indicators in Ukraine

Indicator	2015	2016	2017	2018	2019	2020
Volumes of retail trade, UAH billion	901,9	1031,7	1159,3	1228,9	668,4	795,2
Volumes of Internet trade, UAH billion	12,3	25,5	38,4	48,0	65	76
Annual growth index of Internet commerce, %	75,2%	107,6%	50,4%	25,0%	31%	40%
Penetration of Internet trade in Ukraine, %	1,4%	2,5%	3,3%	3,9%	4,6%	5,5%

The research showed that OLX.ua (40.4% of users), Rozetka.com.ua (32.5%), Prom.ua (26.5%) were among the three most popular e-commerce sites in Ukraine in 2020. You can see that these resources relate to B2B, B2C and C2C relationships. The analysis of business models helped to identify the most successful Ukrainian e-commerce entities and determine which sites were most in demand:

- electronic bulletin boards - sites where individuals or companies place advertising offers of goods and services (OLX, ria.com, shafa.ua);
- e-shops, supermarkets - sale via the Internet of goods purchased from various manufacturers, on their own behalf at their own prices, mainly from their own stocks (Fox trot; Comfy; Metro Ukraine, Rozetka, Modnakasta, Leboutique, LaModa);
- price Aggregators - comparison of offers from different companies (Hotline, Price);
- electronic ordering table - a platform for connecting buyers and service providers (Uber, BlaBlaCar). [15]

To improve the situation with the digitalization of Ukraine, it is necessary to develop a digital strategy that should cover all countries and segments of the population.

The strategy should focus on the structural separation of powers. It should be developed individually for each authority, ministry, region, city (taking into account the population), and village.

The problem of not very great achievements of digitalization is in the orientation of reforms carried out by the state. Most of the changes are comfortable for the urban population (100 thousand +), but a significant part of the population lives in cities less than 100 thousand and in villages.

Digital transformation can only fully realize if high-quality access to communication networks and services and the use of new technologies (described in the second section) and the benefits of their capabilities are available at affordable prices for all people and companies, regardless of who they are and where they live. This includes substantially upgrading infrastructure connections to meet the growing demand for data generated by billions of devices that will be connect to the network in the near future.

The main problems of development of broadband networks are:

- lack of 3G and 4G networks in rural areas and on Ukrainian highways;
- Uneven level of provision of information and reference services to the population by broadband and coverage operators. If we compare the coverage map of

the main operators of Ukraine, we can see their unevenness and rarity in some areas, which is one of the biggest problems;

- low level of broadband coverage.

This situation can change in several ways:

- 1) Encourage companies to distribute coverage in a larger area with tax holidays and a certain period of time with certain conditions;
- 2) Reduce the tax for a certain period of time with certain conditions;
- 3) Create a state operator (this is an idea for the future, at the moment it will be just a waste)

It should also be said about Internet providers, we do not have a national manufacturer, all private. Lack of competition is given in signs

Judging by the data on the social structure of Internet users in Ukraine, the most problematic segment is the elderly (retirees). Today, Ukraine has a population of 42 million, of which 8 million are elderly, which is 20% of the total population. Only 8% of 20% of retirees are Internet users, which is a very low figure. The main problem is the financial security of this segment of the population

The percentage of low-income families and large families who cannot provide children with everything they also need take into account.

In my opinion, the most adaptive solution will be to provide all favorable conditions, for example:

- Provide a counseling center in each town where every elderly person can consult and solve their online problems;
- Adapt social services in each village to help provide online services;
- With regard to low-income children, it is possible to provide all the necessary gadgets, children's centers and libraries.

- Unevenness

The unevenness is that we do not have uniform systems:

- Education: each state university has its own programs, websites, personal offices for students. If you compare the personal account of students from different universities, the functionality, the interface of the personal account is very different.
- Banks: if we compare the level of digitalization of state-owned banks, there is also a big gap between them. Privatbank is very digitalized, but Oschadbank lags behind it by 5 years. This difference felt in everything: from mobile applications to servicing in the bank itself.
- Transport system: when we buy a metro card in Kharkiv, we can't use it in Kyiv and Dnipro. It is much more convenient to make a single system for all cities, but this applies not only to the subway, but also to all transport.

V. CONCLUSIONS

It is established that today the economy of Ukraine has both applied and theoretical and legislative basis in order to strengthen its position among the countries of the world. However, its digitalization is still mostly innovative. Therefore, a combination of theoretical research with modern needs and opportunities is must for the national economy.

Ukraine is a country with great potential. And if we still assess the level of

digitalization, Ukraine is quite a digital country:

- Most government services are available online;
- Convenient sites and a nice interface;
- Sufficient number of companies that provide services online;
- Providing consultations, video lessons on adaptation to new programs;
- Stimulating the development of innovations;
- Grants;
- Encouraging startups.

But for the full digitalization of the country it is necessary to ensure the availability of citizens to these technologies. Digital transformation can only fully realize if high-quality access to communication networks and services and the use of new technologies and the benefits of their capabilities are available at affordable prices for all people and companies, regardless of who they are or where they live.

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