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THE IMPORTANCE OF DIGITIZATION IN THE POST-WAR RECOVERY OF THE ECONOMY

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Original Article

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ABSTRACT

Ukraine has made significant progress in developing digital technologies in recent years, with an average of 289% improvement in Internet access in all regions over the past decade. However, Russia's large-scale aggression against Ukraine is causing severe problems in this area. There is also a digital divide in providing regions of Ukraine with Internet access. As a result of the conflict in Ukraine, attention has been drawn to the need for digital identification solutions: displaced persons often lose access to their physical documents. At the same time, there is an urgent need to confirm their identification data in host countries. If the war continues, the focus must be on keeping businesses and citizens connected to the Internet and modernizing the communications and infrastructure of public services. Digital technologies should become a critical factor in Ukraine's post-war recovery. The study aims to analyze the characteristics of digitalization in terms of infrastructure, public services, and the digital economy. Thus, the study confirms that the reduction in the level of digital inequality has a high correlation with the growth of digitalization. In addition, the development of the level of digitalization is directly proportional to the efficiency of the IT industry. Thus, the IT sector in the first quarter of 2022 provided export revenue of 2 billion US dollars, which is 28% more compared to the previous year. The war caused significant disruptions to the sector, but increased international attention could open substantial opportunities for future development.

Keywords: *digitization, digitization, digital technologies, digital economy, digital divide, digital identification*

1. INTRODUCTION

Such phenomena as digitization, the digital economy, and the introduction of digital technologies are inevitable evolutionary development processes in today's world economy. A key priority under modern realities is the development of digital technologies using all their advantages, including expanding the information base, creating information products, minimizing risks, reducing transaction costs, providing the possibility of remote work, the ability to respond to security challenges quickly, etc.

The rapid modernization of existing digital technologies leads to rapid technological changes characterized by a multiplier effect. Thus, according to McKinsey estimates, one new job in the ICT sector stimulates the creation of 2-4 positions in the economy as a whole and leads to the blurring of geographical and physical borders, opening new perspectives for the economic, social, and cultural development of countries in including for the growth of regional and global competitiveness. Objective digitization processes that will gain momentum require countries, particularly Ukraine,

to formulate a balanced digitalization policy, liberalize the regulation of the industry, adapt the legal framework, increase investment, etc.

In the pre-war period, Ukraine made significant progress in developing digital technologies. In recent years, the share of ICT in the country's GDP was more than 4% and had the potential to grow. According to the results of 2021, compared to 2020, the Ukrainian IT sector grew by 36%, reaching the mark of 6.8 billion US dollars in exports of computer services (against 5 billion US dollars in 2020). The share of IT services exports to Ukraine is about 2.7% of the country's GDP. Before the start of the full-scale aggression, Ukraine was one of the European leaders in the level of development of the field of open data (6th place in the rating European Open Data Maturity 2021). Services based on them were used by about 7 million Ukrainians every month. The share of GDP generated by the field of open data was from 0.8 to 1.3%. As of 01.01.2022, the level of coverage of the rural population by fiber-optic networks and the level of coverage by 4G mobile Internet was 89%. More than 100 electronic public services were available on the Unified State Web Portal of electronic services (75+ through the Portal and 20+ through the mobile application). The transformation of administrative service provision centers at district state administrations has begun, and the network of administrative service provision centers has been expanded to 2,891 access points. Internet access has improved by an average of 289% in all regions over the past decade.

However, Russia's large-scale aggression against Ukraine is causing severe problems in this area. Since the beginning of the active phase of hostilities, the number of vacancies in the IT market in Ukraine has halved. Temporary (for the period of martial law) access restriction to the National Open Data Portal to ensure national security interests. As of June 1, 2022, 22% of optical networks and almost 11% of mobile communication towers have been destroyed. The level of destruction of networks of de-occupied settlements reaches 100% in some places. TsNAP was destroyed in the territories that were or are under temporary occupation, as a result, lack of access to registers and information systems or long-term restoration of access to these systems. There is an increase in demand for public services, particularly electronic ones, considering the circumstances of displacement, loss of documents, etc. Many state information resources were subjected to DDoS attacks. Most of them were simply disabled due to their inability to withstand attacks.

Thus, the critical challenges in the field of digitization in the post-war period are:

- Risks of IT companies changing jurisdiction from Ukrainian to foreign and loss of investment capital, a significant decrease in the quality of access to the Internet, and the appearance of a significant number of people who do not have access to the Internet at all.
- The significant need for receiving public services by people who have left their homes or are in temporarily occupied territories.
- A high level of cyberspace threats requires a quick response, and the readiness of technical means and specialists.

In addition, the priorities in the domestic policy of digital transformations are forming a single digital market with the EU and bringing the structure of the digital sector of Ukraine closer to the requirements of the new reality in the conditions of the war and the post-war period.

2. LITERATURE REVIEW

In modern scientific literature, more publications are appearing on various aspects of digitalization processes. In addition, it should be noted that various areas of digitalization are considered: economy, public administration, medicine, transport, etc.

With the strengthening of the digitalization of the economy, several studies on this matter appeared the raised problem of creating new digital resources, in particular digital duplicates of the organization, is significant. Scientists suggest five principles that assist in constructing an organizational digital twin and show how they combine into a dynamic evolutionary process that builds and maintains the digital twin incrementally. Also they discuss the managerial implications of implementing a digital twin and how digital twins create value in an organization (Parmar, Leiponen, A., & Thomas, 2020). The impact of digital transformation on customer value creation in the context of small and

medium-sized firms with the aim of understanding how dynamic capabilities, as enabling mechanisms, may foster digital transformation considered by Italian scientists Matarazzo, M., Penco, L., Profumo, G., & Quaglia, R., (2021).

A study of the impact of digital financial inclusion on sustainable employment in countries showed that digital financial inclusion should be pursued at a moderate pace, especially in upper-middle-income. Initially, it has a significant promotional impact on sustainable employment. Still, after it surpasses the threshold, this impact is reduced because of the increased cost of digital finance and sustainable development. Thus, if digital financial inclusion is pursued too quickly, a loss in efficiency might follow, which could be avoided by designing a strategy with stability in mind (Geng, Zhechen & He, Guosheng, 2021).

Scientists also pay attention to environmental aspects and examine the influences of digital business and digital public services on environmental innovation (EI) performance in the European region from 2011 to 2019. It is established that European countries should accelerate the digital economy, strengthen the construction of digital infrastructure, and promote digital implementation. Governments should recognize and seize the opportunities presented by digital technology to establish a more effective legislative framework for increasing company technology investment and public attention to environmental improvements (Hung, & Nham, 2023).

More and more scientists are investigating how digitization can be used for education. In addition to teachers in the classroom, parents at home can also play a key role in shaping students' beliefs about digital media, which are essential antecedents of students' use of technology for learning. Most of them focused on how teachers shape technology use. Besides teachers in the classroom, parents at home may also have a pivotal role in shaping students' beliefs towards digital media, which are, in turn, an essential precursor to students' use of technology for learningм (Hammer, Scheiter, & Stürmer, 2021; Kim, Long, Zhao, Zhou, & Alexander, 2021).

Thus, researching how specialists rooted in digital and analog knowledge domains engage in cross-domain collaboration to create digital innovation jointly, scientists concluded that cross-domain education and interdisciplinary training are increasingly important in the digital era. Digital innovation occurs at the intersection of various sources of knowledge. Thus, integrating digital expertise with other domains of knowledge interests researchers and practitioners alike (Pershina, Raissa & Soppe, Birthe & Thune, Taran, 2019).

While education, in general, is a significant driver of social and digital inequality, a country's digital development level is crucial for the less educated sections of society. These findings have theoretical and practical implications: first, they challenge the homogeneity of the causal effect and the assumption that people differ only in terms of motivation, access, and digital skills, and second, the study was conducted in Europe, so they indicate that socially disadvantaged Europeans benefit from living in more digitally developed countries (Lamberti, Lopez-Sintas, & Sukphan, 2021).

Digitization allows businesses better to orient themselves under the emergence of new business environment factors to be more effective and efficient at the global and regional levels (Đukić, 2018).

Digital technologies contribute to introducing flexible methods, procedures, and rules into the work process, increasing business operations' effectiveness (Mićić & Mastilo, 2022).

Digital technologies are becoming extremely important for strategic management and gaining strategic competitive advantages. The basis of digital transformational benefits should be the appropriate organizational structure and culture of the company (Mašić, Vladušić & Nešić, 2018).

Digital innovations are revolutionizing the way companies and industries work. However, the functioning of organizations developing digital innovations is often overlooked. (Hadjielias, Dada, Cruz, Zekas, Christofi, & Sakka, 2021) The study provided insight into how innovation teams function in digital transformation. The results show that digital innovation teams depend on two cognitive states: team-specific cognitions required for digital innovation and digital project-specific cognitions.

One of the most relevant phenomena in digitization is the digital divide. A study of the corporate gap found that all digital technologies innovations must be supported by demand for related skills and should be integrated into an innovation cycle (Shakina, Parshakov, & Alsufiev, 2021).

In martial law and armed conflict conditions, the digitalization of state administration is becoming more relevant. Public sector organizations worldwide use digital platforms as part of their transformation strategy. Based on a case study of the digital transformation of a paperless port in Ghana and technology affordability theory, suggestions are made on how digital platforms can contribute to transforming the public sector (Senyo, Effah, & Osabutey, 2021).

Also relevant in martial law conditions, considering the probability of losing paper documents or the impossibility of physically obtaining them due to forced displacement, is the digital identification of the individual. For example, the UK government recently announced its commitment to developing a secure digital identity for citizens. Following a review of information received from this call, the Government said it is looking to develop proposals for a legal framework to remove regulatory barriers that prevent using secure digital identities and establish safeguards for citizens. It will also develop the next generation of digital identity use in Government and promote a pragmatic approach to international digital identity standards (Seifert, 2020).

3.AIM OF THE RESEARCH

The purpose of the article is to study the factors of digitalization of Ukraine in terms of infrastructure, public services, and digital economy comparing pre-war indicators with those that exist during the war, as well as substantiating the importance of digitalization development in the post-war recovery of the economy.

4.METHODS

I. The methodological basis of the article is formed based on a generalization of the scientific provisions of modern scientific research on digitalization, which consider the objectivity of changes occurring under the influence of the development of a dynamic environment. Data processing for this article involved the use of the following methods of data analysis: methods of statistical qualitative and quantitative comparison, analytical, graphic, and tabular methods. The development and substantiation of the study›s theoretical, methodological, and applied foundations are based on a significant amount of informational and analytical material, which provides an opportunity to form a comprehensive approach to substantiating the importance of digitization in post-war economic recovery. The conclusions of the conducted research were formulated using the methods of abstract specification, generalization, structural-genetic analysis, and synthesis of the obtained results.

II. One of the critical issues in increasing the country›s digitization level is the assessment of its overall level, which is logically carried out by comparing it with other countries according to a set of primary and synthesized indicators.

At the international level, many synthetic indicators are calculated that describe the degree of development of digitalization processes in different countries based on combining partial indicators into synthetic indicators, comparing their values, and determining the overall level of the state. Some of these indicators are currently no longer calculated (e-Intensity (Boston Consulting Group); IDI (ICT Development Index)), and some are calculated only at the regional level - DESI (Digital Economy and Society Index). For the analysis, it is worth using the information on the methodology of calculations of such indices as DEI (Digital Evolution Index); GII (Global Innovation Index); NRI (Networked Readiness Index); WDCI (IMD World Digital Competitiveness Index); DAI (Digital Adoption Index) and information from the Digital Development Dashboard.

It was determined that the assessment of the specified level for the countries of the world should be carried out based on synthetic indicators, which in turn are based on the calculations of primary indicators, analyzing the approaches to assessing the level of digitization at the global level and the methods of calculating the specified indicators.

Summarizing the mentioned approaches, we singled out five generalized synthetic indicators that will form an integral value: Digital/Technological skills are readily available; Digital Business; Digital Governance; Infrastructure; Level of internet activity/mobility. The first three indicators were selected as sub-indices from existing indicators: Digital/Technological skills are readily available – 3

IMD World Digital Competitiveness Index; Digital Business and Digital Governance – Networked Readiness Index.

Two other sub-indices are proposed to be calculated based on partial indicators:

Infrastructure: Active mobile-broadband subscriptions per 100 inhabitants; Fixed broadband basket as a % of GNI p.c.; Fixed broadband subscriptions per 100 inhabitants; Fixed-telephone subscriptions per 100 inhabitants; Households with a computer at home (%); Households with Internet access at home (%); International bandwidth per Internet user (kbit/s).

Level of Internet activity/mobility:

- Individuals using the Internet, total (%)
- Mobile cellular basket as a % of GNI p.c.
- Mobile-cellular subscriptions per 100 inhabitants
- Population covered by at least a 4G mobile network (%)
- Monthly fixed broadband Internet traffic per fixed broadband subscription (MB)
- Monthly mobile broadband Internet traffic per mobile broadband subscription (MB)
- Population covered by a mobile-cellular network (%)

II. The preliminary analysis of the partial indicators must be carried out to determine the practicality of including the specified indices in the sub-index. One of the methods is the clustering method, but to assess the degree of influence of each indicator on the assignment of the research object to the appropriate group. The most common clustering methods are tree-like (hierarchical) and the k-means method.

The hierarchical method involves the sequential merging of smaller clusters into larger ones or the division of larger clusters into smaller ones. The calculation uses similarity measures to calculate the distance between objects, called distance metrics or pounds. Similarity measures are calculated using different methods: squared Euclidean distance, Manhattan distance, Chebyshev distance, nearest neighbor or single bond method, Ward method, unweighted pairwise average method, etc. (Sneath, and Sokal, 1973, Ward, 1963). In our study, we will use the Ward method, as it allows us to obtain compactly grouped clusters. The essence of this method involves the preliminary normalization of the initial data, then the calculation of the matrix of distances or the matrix of similarity measures; after that, a pair of closest clusters merge, and a new cluster is assigned the lower number of connecting clusters. The sum of squares of the distance is calculated according to the formula to form a cluster (Klebanova, Hur'ianova, Chahovets', Panasenko, Serhiienko, Yatsenko, 2020):

$$V_k = \sum_{j=1}^{k} \sum_{x \in C_j} (x_{ij} - \mu_j)^2 \quad (1)$$

In the future, at each step of the algorithm, those objects or clusters that give the smallest increase in each value are combined

As a result of this analysis, a preliminary number of clusters is obtained, which are then used in the k-means method.

The essence of the k-means method is to select the initial center of clusters as a weighted average for each indicator: , ... (Hastie, Tibshirani, Friedman, 2001).

The object separation algorithm is based on cluster distance minimization. If the mean square norm is used as the distance, then the objective function looks like this:

$$J = \sum_{j=1}^{k} \sum_{x \in C_j} ||x_i - \mu_j||^2 \quad (2)$$

where – i-th object, and – j-th cluster with center;

x – feature vectors of the classification object

After that, find the distance from the point to the center of the clusters built in the 1st step and assign this point to the cluster with the minimum distance. A new center of gravity is then calculated , and the weight of the cluster increases by one:

$$\mu_j = \frac{1}{n_j}\sum_{x \in C_j} x \tag{3}$$

for everyone *i* and such that is calculated:

$$h = argmin\left\{\frac{n_j \| x_{ij} - \mu_j \|2}{n_j - 1}\right\} \tag{4}$$

where the number of cluster objects

If the condition is met:

$$\frac{n_h \| x_i - \mu_h \|2}{n_h - 1} < \frac{n_h \| x_i - \mu_j \|2}{n_h - 1} \tag{5}$$

you should move the object from the cluster into a cluster , after which you should list the values of the centers. The iteration ends when the objective function of the given threshold value is reached.

According to the cluster analysis results, in addition to grouping objects into separate smaller sets using the k-means method, it is possible to determine the degree of influence of these variables on the distribution. The value of this coefficient and its statistical significance (<0,05) make it possible to attribute the primary indicator to the set of those that should be considered in the calculation of the sub-index. After that, all the primary indicators that remain in the model are standardized, and the arithmetic mean is calculated based on their values, which is used as the level of the synthetic indicator.

III. The taxonomy method is used to calculate the integral value of the digitization level, the content of which is given in fig. 1.

The matrix of observations (X) has the following form:

$$\mathrm{X} = [\mathrm{x}_{ij}] \tag{6}$$

where *j* - the country number (j = 1, ..., m);

i - indicator number (I = 1, ..., n);

x_{ij} - the value of the *i*-th indicator for the *j*-th country.

S – standard deviation;

Z_{is} - the standardized value of the characteristic s for the unit *i*;

m - the number of countries.

As a result of the calculation, the rating of the study countries is obtained, which allows us to qualitatively characterize their level of development in the field of digitalization and to identify weak points for each country based on interval values.

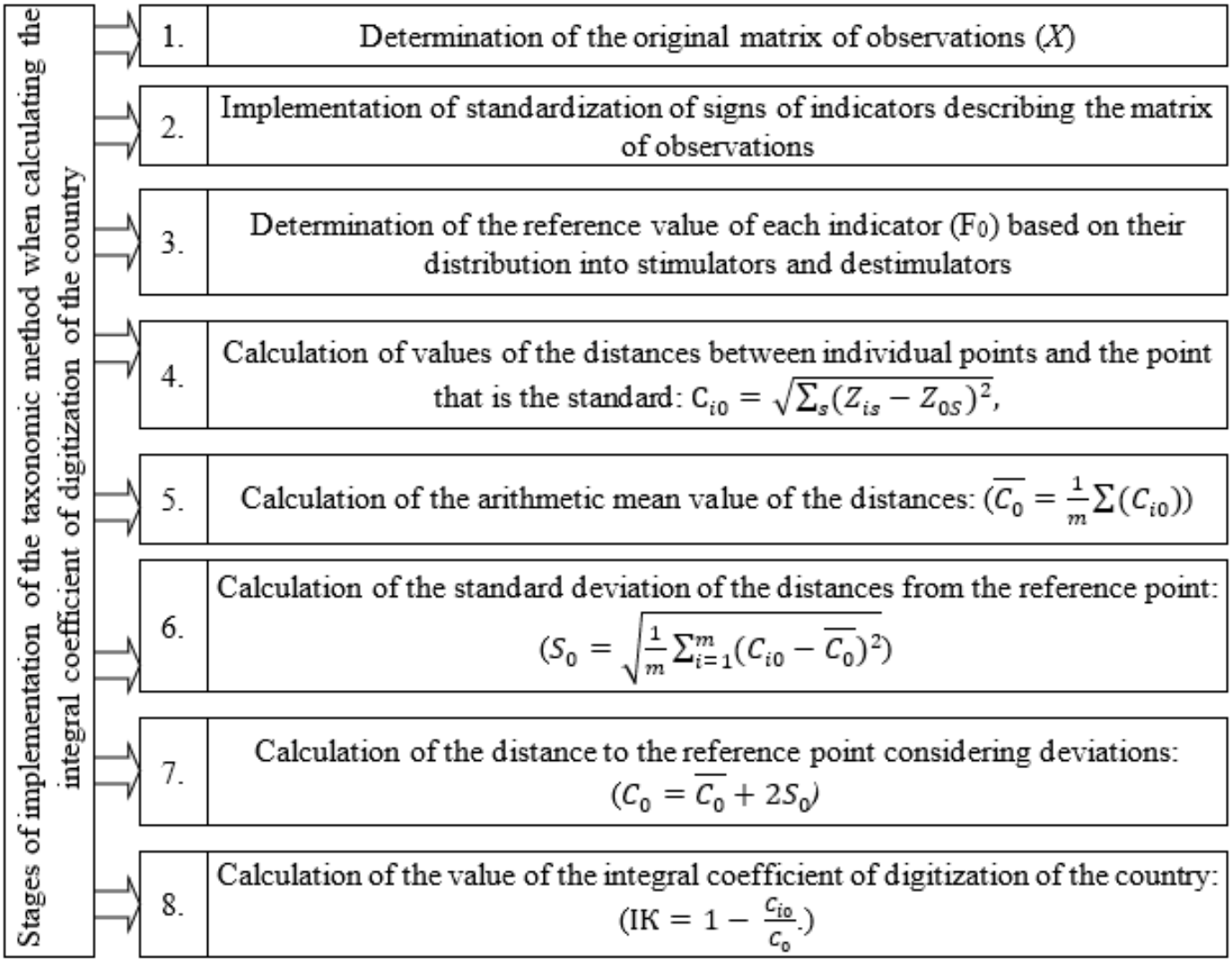
5. RESULTS

Digitalization has been changing our world, lives, and work processes in recent years. Both in professional and personal everyday life, humanity has inevitably become a part of this digital transformation. To adapt to these changes, we need digital skills and competencies: regardless of age, education, or background. Each member of society must be able to respond appropriately and at his discretion to the needs and requirements of digitalization. That is, as the key to information, media, and information literacy is part of the state's responsibility to ensure the right to education, freedom of expression, and democracy of all citizens.

The coronavirus pandemic became a vivid example of the critical importance of digital information, digital communication, and all kinds of digital tools: the Internet has become an essential means of information, education, trade, remote work, shopping, entertainment, and often necessary tool for connecting with relatives, celebrating, honoring the memory, receiving medical information and services. It was a turning point when access to digital communication and the Internet became necessary in professional life and everyday life. That is, access to the Internet has become a "com-

mon good," the same as electricity or water, so digitalization is a critically important element of modern society.

Figure 1. Algorithm for calculating the integral coefficient of digitization of the country



Source: (Plyuta, V., 1980)

Digitalization processes continue to cover the most remote corners of the planet and an ever-increasing range of spheres of people's lives. Digitization became the first pressing issue on the World Economic Forum 2020 agenda. So, as of April 2022, according to DataReportal, We Are Social, and Hootsuite, there were 7.91 billion people worldwide, of which 57% are urban dwellers. There are 4.95 billion Internet users, which is 62.5% of the planet's total population. In addition, 5.31 billion have a mobile phone (67.1% of the Earth's total population). At the same time, 58.4% of the population, i.e., 4.62 billion people, actively use social networks.

If we analyze retrospective data, at the beginning of the introduction of the global Internet network, there were commercial restrictions on the use of sites, which inhibited the spread of the Internet; when after 1995, they were removed - the number of users increased from 4 million to 50 million in a relatively short time. If we talk about defining scales, the milestone of 1 billion users was overcome around 2005. In 2011 - this figure doubled and reached the mark of 2 billion users, and in 2015 there were already 3 billion network users in the world the Internet, and in 2017 half of the planet's inhabitants used the Internet. However, it is worth noting that in recent years we have seen a slowdown in the growth rate of the Internet's popularity - only 4%, which is quite natural since today, 6 out of 10 inhabitants of the planet are online.

Despite all these positive indicators, about 2.9 billion people still do not use the Internet, which is 37% of the Earth's population, with more than 1/3 of this number living in Southeast Asia.

Every active Internet user spends about 40% of their life on it if we count only the waking hours - an average of almost 7 hours (6 h, 53 min). Young people usually spend more time on the Internet than representatives of the older generation. Young women are especially active in this sense. Statistics show that women between 16 and 24 now spend 8 hours a day on the Internet, meaning many spend as much time online as they do sleep. Men born in 1945-65 spend the least time online - about 5.5 hours daily. Lower Internet awareness occurs daily among older and less educated women from poor countries. Globally, men account for 18% more social media users than women. At the same time, in South Asia, men use social networks almost 2.5 times more often than women. Research shows that the primary motivation for using the Internet, as before, is the search for information (60.2% of 16- to 64-year-olds cited this as one of the main reasons for going online in the fourth quarter of 2021). The second place was maintaining contact with friends and family - 54.7%. The third most common reason for going online was cheating and watching the news: 52.3% of working-age internet users named it their primary motivation. More than half of users (50.3%) cited the search for entertaining video content as the fourth reason in the latest global ranking for accessing the Internet. Also, a relatively high place in the order of reasons to go online is occupied by commercial activities, the search for products and services.

Based on the provided research methodology, a cluster analysis and statistical analysis of the distribution of values by sub-indices Infrastructure and Level of internet activity/mobility was first carried out (Table 1, Figs. 2 and 3). From the cluster analysis, out of 7 indicators, six remained, as the last one was statistically insignificant. This shows that the countries are similar in terms of this coefficient, and it can be excluded from the analysis.

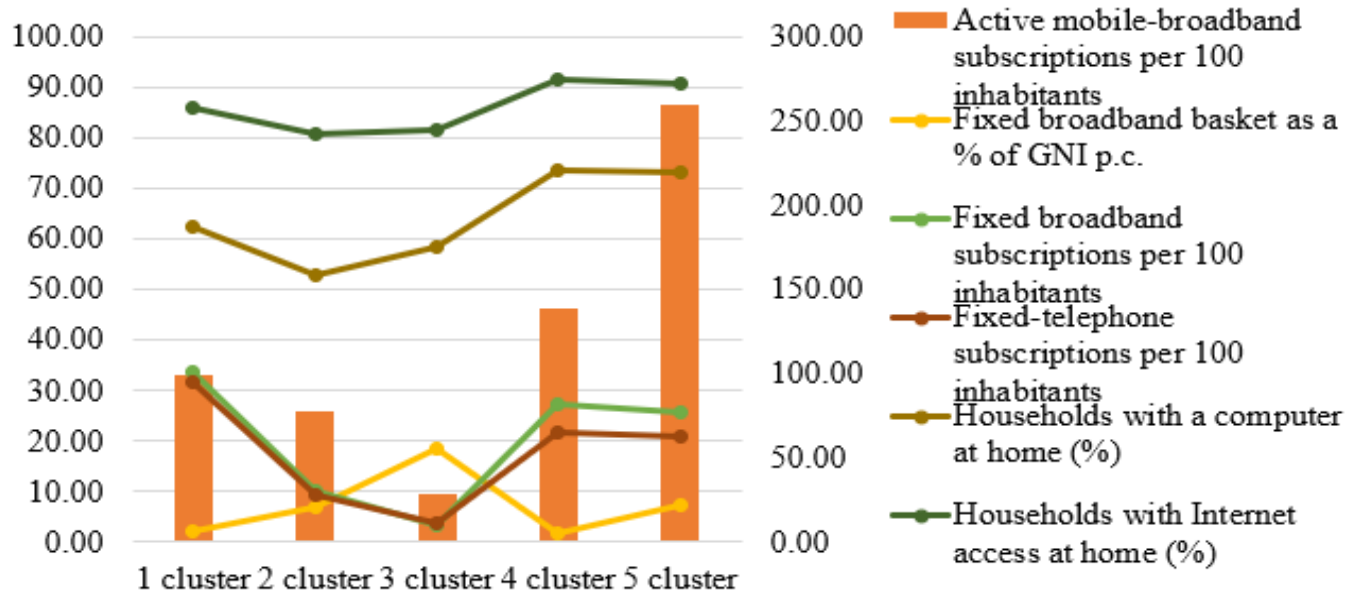
Table 1. Results of statistical analysis by sub-index Infrastructure

Indexes	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Std. Dev.	Результаті кластерного аналізу	
								F	signif. P
Active mobile-broadband subscriptions per 100 inhabitants	79,64	78,96	0,49	338,48	46,53	105,48	49,07	341,18 (6)	0,000000
Fixed broadband basket as a % of GNI p.c.	8,70	4,48	0,33	71,05	1,55	9,50	11,58	23,87 (3)	0,000000
Fixed broadband subscriptions per 100 inhabitants	16,22	11,60	0,00	57,70	1,30	29,50	15,40	85,61 (5)	0,000000
Fixed-telephone subscriptions per 100 inhabitants	14,92	11,75	0,00	116,70	2,27	20,87	16,26	40,44 (4)	0,000000
Households with a computer at home (%)	59,61	59,60	8,70	99,50	59,60	59,60	12,82	15,85 (2)	0,000000
Households with Internet access at home (%)	83,72	83,70	30,00	100,00	83,70	85,07	9,96	7,26 (1)	0,000019

Source: calculated by the authors

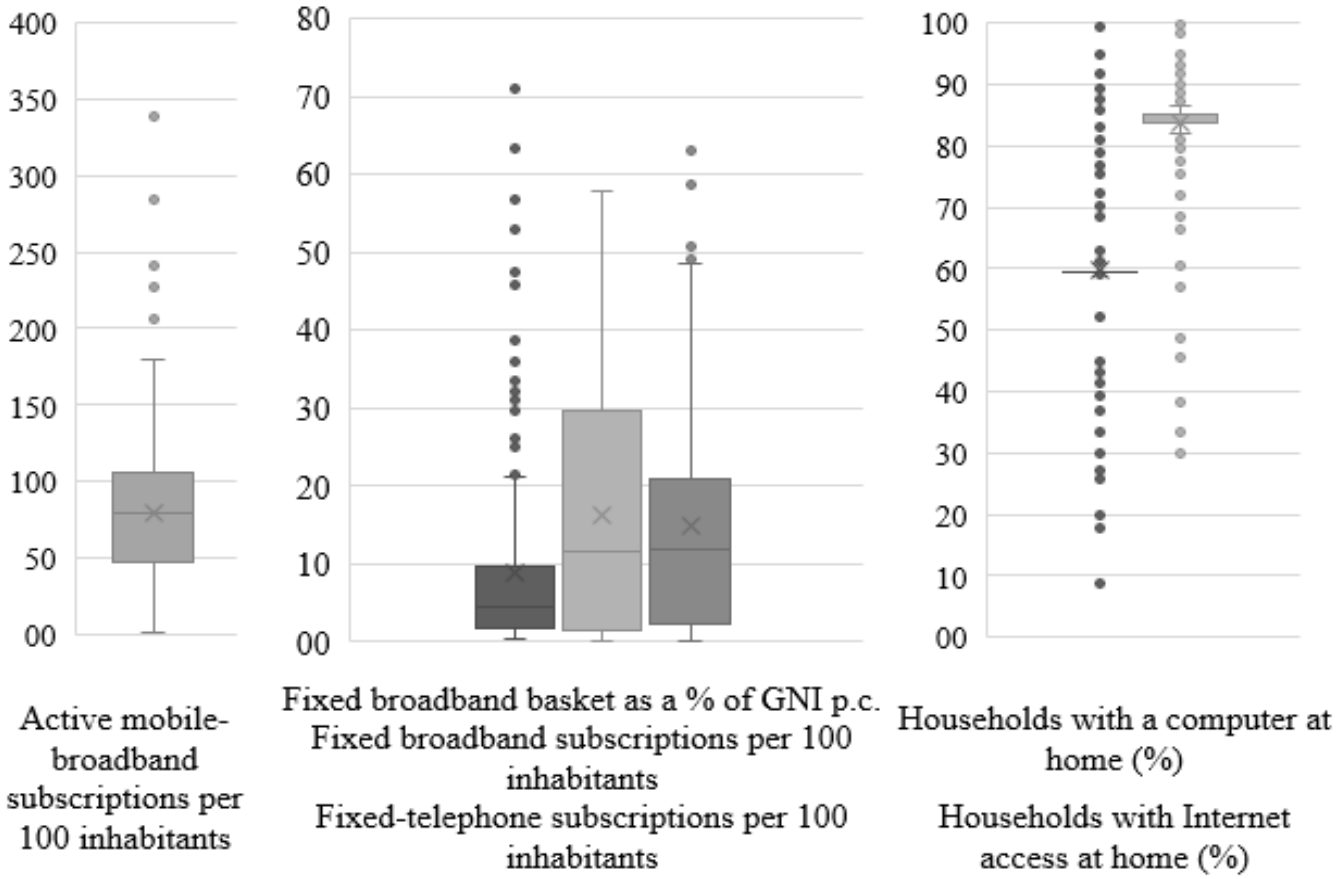
It is worth noting that the average value is very close to the median except for the fixed broadband basket as a % of GNI p.c., confirming the normal distribution approximation. The importance of the lower and upper quartiles is presented in fig. According to the indicator of active mobile broadband subscriptions per 100 inhabitants, Ukraine occupies an intermediate place because the value is very close to the average; instead, according to the fixed broadband basket as a % of GNI p.c. Ukraine occupies one of the lowest places, which indicates its backwardness in this parameter, and to increase the level of its digital development, it is worth concentrating efforts on increasing its value. According to the indicator of fixed broadband subscriptions per 100 inhabitants, the value of Ukraine is higher than the average. According to the following hand - Fixed-telephone subscriptions per 100 inhabitants - Ukraine is significantly inferior to the world average. For Ukraine, such a phenomenon is logical because the population has begun to abandon fixed communication in favor of mobile. On the other hand, this indicator is calculated as a component of digitalization, and because of the potential future increase in mobile communication fees, support for landlines is appropriate.

Figure 2. Classification of country grouping clusters by indices Infrastructure



Source: calculated by the authors

Figure 3. Statistical analysis of the primary indicators of the sub-index Infrastructure



Source: calculated by the authors

The value of households with a computer at home (%) in Ukraine is equal to the average. Still, this infrastructural indicator is fundamental for the country's future digital development, which requires special programs to increase the population's access to standard computer equipment. This task is difficult in the conditions of war because of the unfavorable economic situation and economic stagnation. But in the future, in the post-war period, this requires specific financing (credit programs) and spreading awareness of the use of this technology, especially among the elderly population. A similar situation with Internet access - households with Internet access at home (%) - the value in Ukraine is like the world average, but in general, it is significantly higher than the previous one,

which indicates a more active use of alternative access to the Internet from home, except for stationary computers - that is, through phones and tablets. This indicator indirectly indicates a sufficiently high level of use of these devices by households. In general, Ukraine is inferior to the world's countries in 2 indicators of this group: Fixed broadband basket as a % of GNI p.c. and Fixed-telephone subscriptions per 100 inhabitants. But the main efforts should be focused on raising the level of the first of them.

Grouping by clusters shows that the most significant contribution to the distribution of countries among the primary indices belongs to 1 of them - active mobile-broadband subscriptions per 100 inhabitants. In all other countries, the differences are much more minor, and the most similar countries are the level of access to the Internet from home.

A similar analysis was conducted based on the primary indicators of the Level of internet activity/mobility sub-index (Table 2, Figs. 4 and 5).

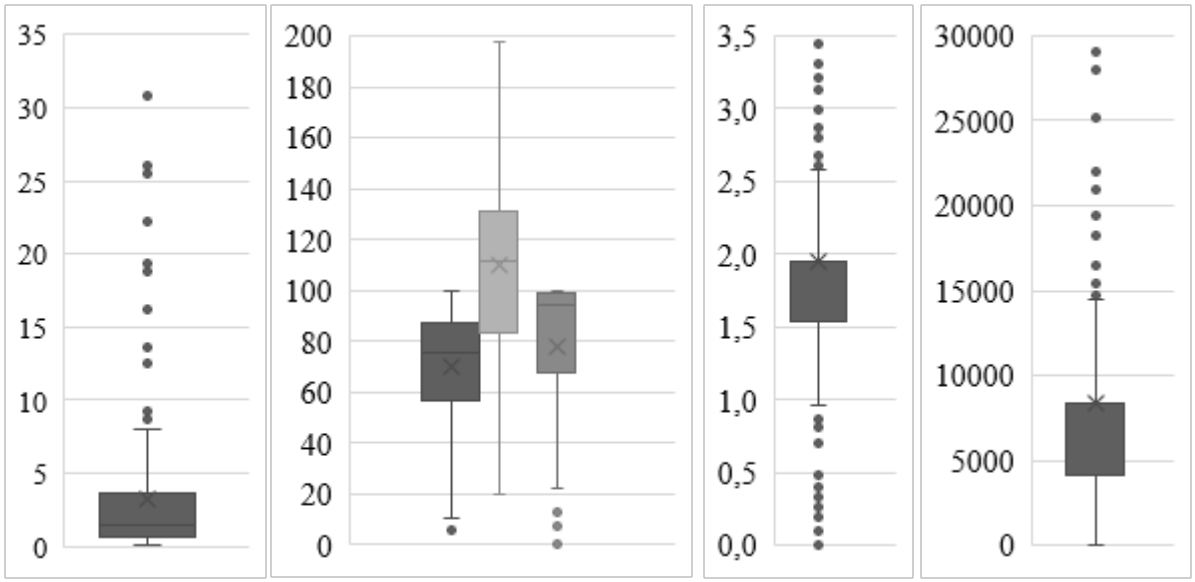
Table 2. Results of statistical analysis by sub-index Level of internet activity/mobility

Indexes	Mean	Median	Minimum	Maxi-mum	Lower Quartile	Upper Quartile	Std.Dev.	Результаті кластерного аналізу	
								F	signif. P
Mobile cellular basket as a % of GNI p.c.	3,2	1,5	0,05	30,8	0,6	3,7	4,8	2,44 (1)	0,049
Individuals using the Internet, total (%)	69,7	75,7	5,80	100,0	57,1	87,2	23,4	7,33 (5)	0,000
Mobile-cellular subscriptions per 100 inhabitants	109,8	111,7	19,45	406,8	84,8	130,9	43,7	3,09 (2)	0,017
Population covered by at least a 4G mobile network (%)	78,1	94,0	0,00	100,0	67,7	99,0	29,1	3,29 (3)	0,012
Monthly fixed broadband Internet traffic per fixed broadband subscription (MB)	195357,1	195357,1	0,00	873711,1	154958,4	195357,1	118230,5	731,09 (6)	0,000
Monthly mobile broadband Internet traffic per mobile broadband subscription (MB)	8355,4	8355,4	0,00	92062,7	4173,5	8355,4	8881,4	4,35 (4)	0,002

Source: calculated by the authors

Based on the calculations, we note that all indicators were statistically significant, except for the last Population covered by a mobile-cellular network (%). According to this indicator, the countries do not differ so it can be excluded from the analysis. According to the mobile cellular basket index as a % of GNI p.c. Ukraine is significantly inferior to other countries but falls on the median. The difference between the average and the median indicates that there are outliers in the countries that affect the homogeneity of the research sample. Therefore, Ukraine falls precisely in the middle, inferior to the average value of this index for other countries. On the other hand, Ukraine exceeds the average values for three other indicators (Mobile cellular basket as a % of GNI p.c.; Mobile-cellular subscriptions per 100 inhabitants; Population covered by at least a 4G mobile network (%)), even exceeding the median for the first two. 4G Internet coverage remains a bottleneck for our country, which holds back the pace of digitalization of society. In the post-war period, it will be fundamental not only to restore this coverage in the affected regions but also to fully cover the entire rural area, which traditionally suffers in this aspect. According to the latest indicators, Ukraine's digitization rate corresponds to the global average.

Figure 4. Statistical analysis of the primary indicators of the sub-index Level of internet activity/mobility



Mobile cellular basket as a % of GNI p.c.

Individuals using the Internet, total (%)

Mobile-cellular subscriptions per 100 inhabitants

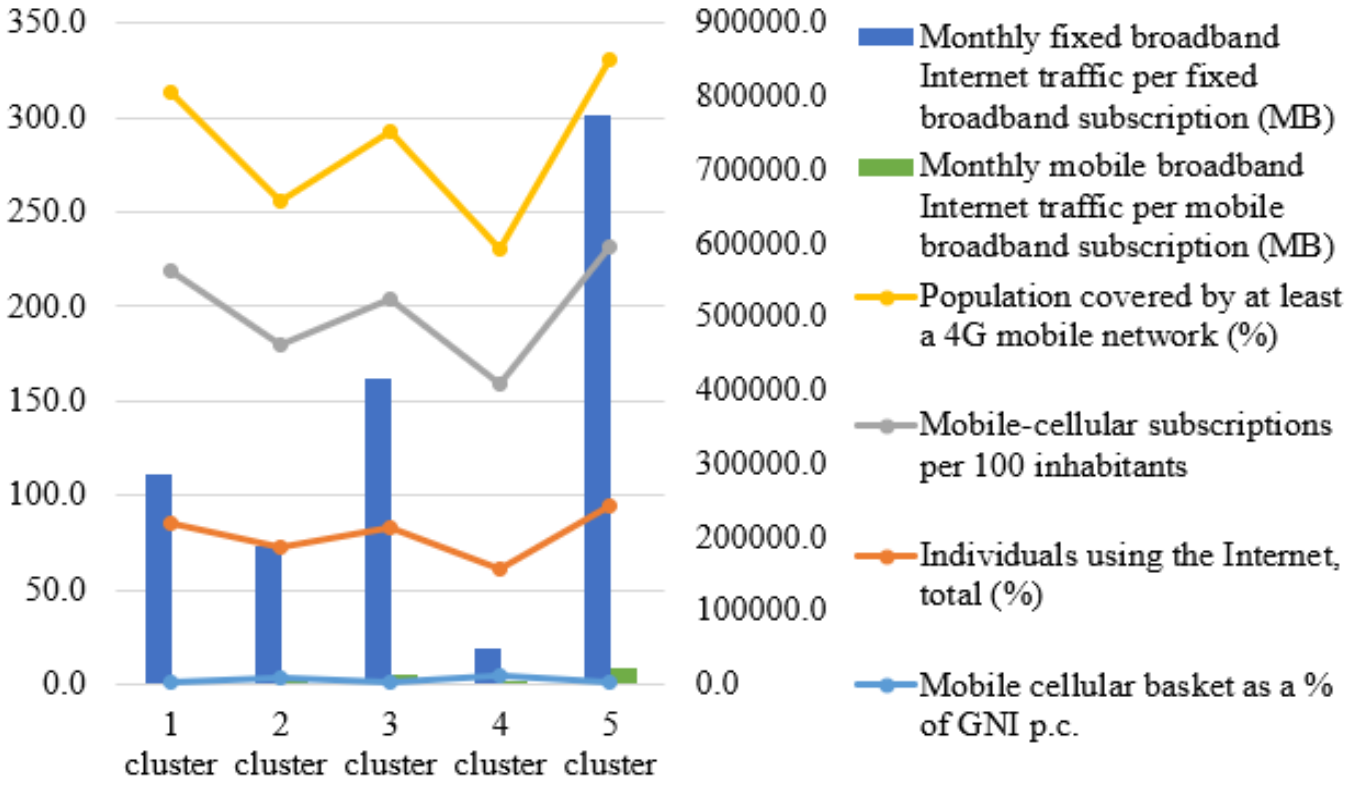
Population covered by at least a 4G mobile network (%)

Monthly fixed broadband Internet traffic per fixed broadband subscription (MB)

Monthly mobile broadband Internet traffic per mobile broadband subscription (MB)

Source: calculated by the authors

Figure 5. Classification of country grouping clusters by indices of Level of internet activity/mobility



Source: calculated by the authors

According to the nature of the influence of the studied indicators on the distribution of objects, it is worth noting an even greater spread of values than in the previous sub-index: the decisive section depends on the importance of monthly fixed broadband Internet traffic per fixed broadband sub-

scription (MB), and the countries differ the least according to the mobile cellular index basket as a % of GNI p.c. The results of the calculations of all five sub-indices of the general digitization coefficient of the world's countries are presented in the table. 3.

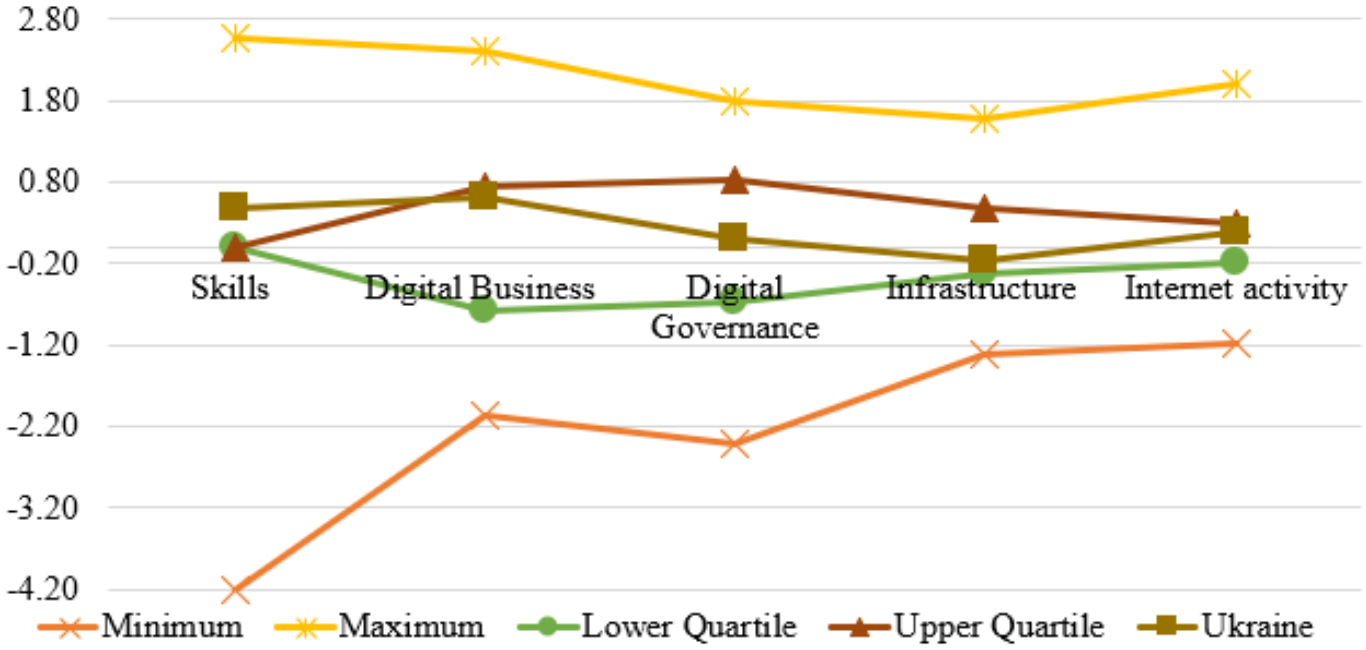
Table 3. The value of the sub-indices of the calculation of the integral coefficient of digitization of the countries of the world

Indexes	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Std.Dev.
Digital/Technological skills are readily available	0,00	0,00	-4,20	2,58	0,00	0,01	1,00
Digital Business	0,00	0,00	-2,06	2,41	-0,77	0,74	1,00
Digital Governance	0,00	-0,12	-2,41	1,80	-0,68	0,84	1,00
Infrastructure	0,06	-0,05	-1,31	1,57	-0,31	0,47	0,54
Level of internet activity/mobility	0,07	0,13	-1,17	2,01	-0,20	0,30	0,48

Source: calculated by the authors

The place of Ukraine among these values is given in fig. 6. Such an interpretation makes it possible to determine those areas of digitalization in which Ukraine has a relatively high value and those in which it lags global trends. As we can see, the situation is the best according to the sub-index of digital abilities and skills, which reflects the high level of progress of the human capital of Ukrainians and indicates their increased ability to perceive new information. Also, the level of digitalization of business is relatively high in Ukraine. This indicator also indirectly confirms the Ukrainian nation's high intellectualization level. According to the Internet activity and mobility indicator, Ukraine falls between 2 quartiles, although their difference is not significant enough.

Figure 6. The value of sub-indexes



Source: calculated by the authors

According to the value of the digital government sub-index, Ukraine is in the middle between the cartels, reflecting the average value for the sample. This situation demonstrates the weakness of institutions in our country, which requires a review of the digitalization policy and a reduction in the overall level of bureaucracy in Ukraine. They say that the electronic tool, which is quite successfully implemented in our country, simplifies the population's life. However, it has many errors (Action, Electronic medical system, Electronic educational services, etc.). The primary post-war task is to

revise the existing protocols for the functioning of these systems to avoid problems and eliminate errors to increase the state's cyber security level. As we can see, the worst situation has developed for the sub-index of infrastructure, the implementation of which is the most difficult due to significant capital costs to eliminate the digital divide.

Correlation analysis between the considered sub-indices (table 4, Fig. 7) allows you to determine where the closest connection exists between them. The most significant relationship exists between digital government and digital business. Therefore, further deepening of digitalization of the interaction process between government and industry will contribute to the growth of digitalization of the country. There is also a strong connection between infrastructure and digital government, less so between it and digital business. The level of digital abilities and capabilities does not correlate with others, which indicates its trajectory of dynamics. The Internet and mobile activity level is weakly correlated with other sub-indices, but the connection exists.

Table 4. Correlation matrix of sub-indices for calculating the integral coefficient of digitization of the countries of the world

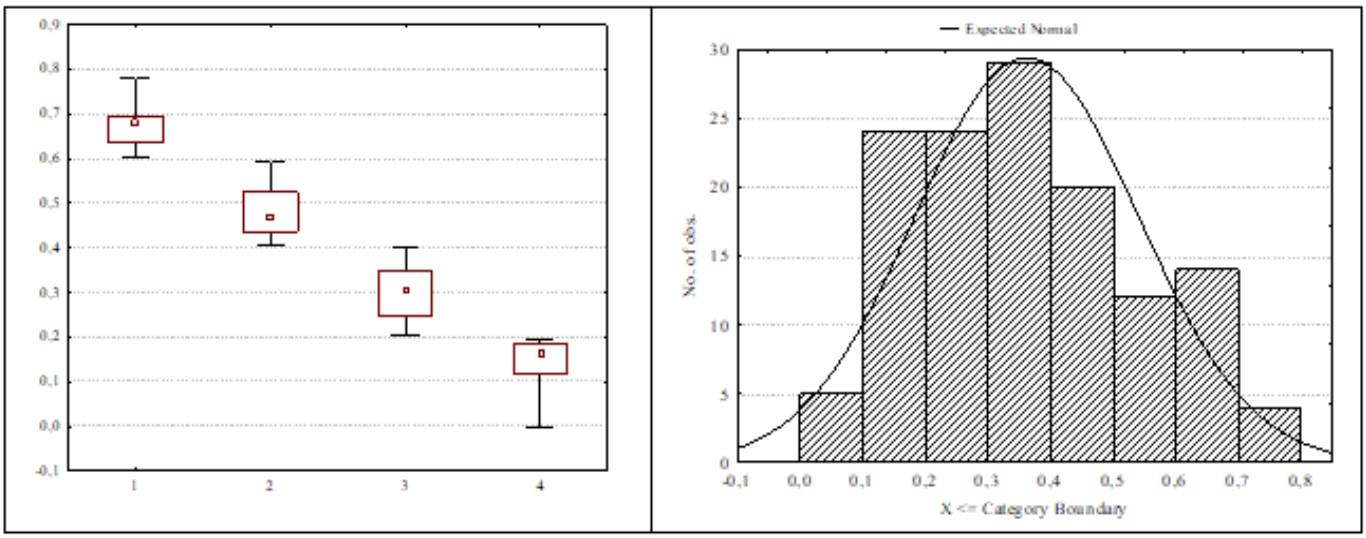
Sub-indexes	Digital/ Technological skills are readily available	Digital Business	Digital Governance	Infrastructure	Level of internet activity/ mobility
Digital/ Technological skills are readily available	1,0000	0,2373	0,2402	0,2803	0,1777
Digital Business	0,2373	1,0000	***0,8954***	***0,6960***	0,6203
Digital Governance	0,2402	0,8954	1,0000	***0,7115***	0,6258
Infrastructure	0,2803	0,6960	0,7115	1,0000	0,4855
Level of internet activity/mobility	0,1777	0,6203	0,6258	0,4855	1,0000

Source: calculated by the authors

The obtained correlation substantiates the expediency of implementing maximum efforts in the direction of the further development of the digital society in Ukraine in the post-war period in the order of the development of electronic governance both because of the high degree of its correlation with other sub-indices and because of the lowest level among the calculated ones.

The results of the grouping of the studied countries according to the level of the integral coefficient of digitization, calculated by the taxonomic method, are presented in Fig. The interpretation of the value of this coefficient is quite simple: the closer the value is to "1", the higher the level.

Figure 7. The results of the grouping of the studied countries by the integral coefficient of digitization



Source: calculated by the authors

The spread of integral coefficient values has a left-symmetric distribution. In most countries, digitization is low and very low, and Ukraine falls into the middle-level group, demonstrating relatively reasonable rates of digital society formation. The obtained results are also confirmed by partial indicators, the analysis of which is given above.

Table 5. Classification of coins by the value of the integral digitization index

Groups	Range	Description	Representatives
1	[0,8; 0,6)	High level of digitization (18)	Denmark (1); Finland; Singapore; Sweden; United States; Switzerland; Iceland; United Arab Emirates; Netherlands; Norway; Hong Kong, China; Lithuania; Canada; United Kingdom; Israel; Saudi Arabia; China; Portugal (18)
2	(0,6; 0,4]	Average level of digitization (32)	Korea, Rep. (19); Luxembourg; Qatar; France; Malaysia; Slovenia; Latvia; Belgium; Spain; Ireland; Malta; New Zealand; Estonia; Australia; Austria; Chile; Cyprus; Bahrain; ***Ukraine (37)***; Kuwait; Czech Republic; Uruguay; Greece; Jordan; Oman; Serbia; Romania; Türkiye; Slovakia; Taiwan, China; Italy; Bulgaria (50);
3	(0,4; 0,2]	Low level of digitization (53)	Thailand (51); Russian Federation; Georgia; Armenia; Montenegro; Germany; India; Moldova; North Macedonia; Croatia; Costa Rica; Albania; Iran, Islamic Rep.; Azerbaijan; Mauritius; Kazakhstan; Jamaica; Morocco; Tunisia; Viet Nam; Trinidad and Tobago; Dominican Republic; Panama; Egypt; Kenya; Sri Lanka; Bosnia and Herzegovina; Kyrgyzstan; Poland; Lebanon; Cabo Verde; Ecuador; Indonesia; Rwanda; Algeria; Senegal; Ghana; El Salvador; Cote d'Ivoire; Hungary; Mexico; Paraguay; Cambodia; Honduras; Bolivia; Benin; Pakistan; Colombia; Argentina; Bangladesh; Namibia; Zambia; Brazil (103)
4	(0,2; 0]	Very low level of digitization (29)	Nigeria (104); Eswatini; South Africa; Philippines; Mongolia; Madagascar; Tajikistan; Zimbabwe; Cameroon; Tanzania; Nepal; Lao PDR; Burkina Faso; Japan; Malawi; Guatemala; Lesotho; Gambia; Mozambique; Peru; Mali; Uganda; Guinea; Angola; Congo, Dem. Rep.; Ethiopia; Chad; Burundi; Botswana (132)

Source: generalized by the authors

As a result of the research, we proposed our systematic approach to calculating the integral coefficient of digitalization of Ukrainian society, which is based on five sub-indices, three of which are used from universally recognized world coefficients, and two are proposed to be calculated from partial indices according to our own author's methodology. Based on the calculations, a close relationship between the considered sub-indices was revealed based on the values of the correlation matrix - the highest relationship was found between digital business and e-government. In addition, it was established that Ukraine has lower values in comparison with other countries of the world than other sub-indices and a lower level was found for infrastructure components, where Ukraine approaches the lower quartile of the spread of values. In addition, the infrastructure sub-index also has a close correlation with digital business and e-government. Thus, the primary efforts to increase the development of the digital society in the post-war period should be directed at improving the functioning mechanisms of the electronic government and financing the creation of the corresponding infrastructure.

Moving from the global indicators to the digitalization indicators of Ukraine, it is worth saying that according to the international ratings in 2020, Ukraine took 40th place in the Networked Readiness Index (WEF) rating, while in 2016, it was only in 64th place; in the Global Innovation Index rating (INSEAD, WIPO) in 2020, Ukraine increased its rating by 16 positions compared to 2016 - from 56 in 2016 to 40 in 2020; in the ranking of the Global Competitiveness Index (WEF) in 2020, the position strengthened by 35 points compared to 2016 - from 85th place to 50th (cumulative index), which is relatively high indicators.

According to the State Committee of Statistics 2016, there were 14.2 million Internet users in Ukraine, while at the beginning of 2021, this figure doubled to almost 29 million subscribers. The share of Internet users among the population aged 12 to 65 living in cities with more than 50,000 is currently 87%. Over the past five years, most Ukrainians have started using the Internet. At the same time, the growth of this indicator occurs at the expense of small settlements (cities with a population of less than 50 thousand inhabitants and villages). Thus, over the past two years, the number of users in towns with a population of less than 50,000 inhabitants has increased by 10% and in villages - by 18%, respectively.

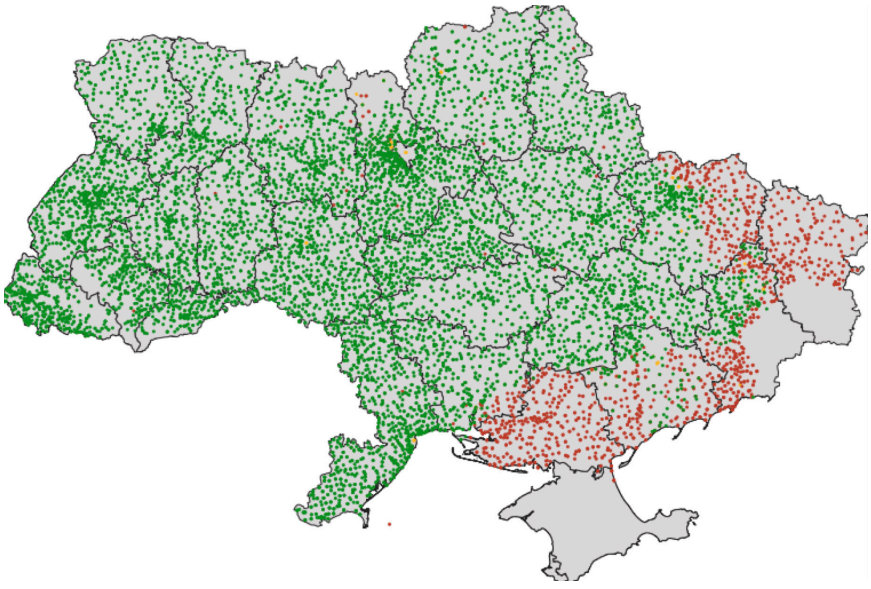
A characteristic sign of the Ukrainian digitalization of society is the growth in Internet users among audiences aged 14-35, approaching 100%. At the same time, there is also an increase in the number of users of an older audience, especially in the age segment of 46-55 years, where this indicator has increased by 20% since 2018, and in the part of 56-70 years - for the same period, it showed an increase of as much as 60%.

Ukraine has somewhat developed broadband access to the Internet, occupying the 77th position in the ranking out of 224 countries and ahead of neighboring countries such as Belarus, Georgia, and Turkey in terms of average connection speed.

According to the State Committee of Statistics, in 2016, there were 14.1 million subscribers of broadband access, and in 2020 there were already 25 million of them; today, most Ukrainians have high-speed access to the Internet. Active penetration of mobile Internet began with the launch of 3G Internet in 2015 when leading Ukrainian mobile operators received licenses. In 2016, 44% of Internet users connected to the network via a smartphone, and in 2021, about 90% of them were already.

Recently, there has been a phenomenon called the “mobile-first generation,” for whom the smartphone is the leading and only device for using the Internet: according to research, for 90% of Internet users aged 12-70, the smartphone is the primary device for using Internet networks, while computers have decreased their share by 42% over the past three years. However, it is worth adding that, on average, one Ukrainian has 2.4 devices; computers, laptops, and tablets have yet to lose their relevance (Fig. 8).

Figure 8. Distribution of non-working mobile base stations



Source: (Kyiv School of Economics)

A prerequisite for the stability and further development of the digital economy is a connection to the global Internet network, which causes serious problems in a large-scale war. Thus, since the beginning of the war, as of May 2022, the quality of data transmission in fixed Internet networks has decreased by an average of 13% and in mobile networks by 26%. In addition, about 12.2% of settlements need access to mobile communication, and 3.1% have only partial access. After the de-occupation of accommodations, the destruction of networks reaches 100%. Stations of mobile operators in different parts of the country were damaged: 3,534 base stations of mobile operators, that is,

almost 11% of them are inactive, and this share is growing. Access to a stable, reliable high-speed broadband network is a critical framework condition for the recovery and development of Ukraine's digital economy.

According to the calculations of the Derzhkomstat, at least 726 operators of electronic communications of fixed access to Internet networks suffered losses because of military operations. The total direct losses of telecom operators are estimated at $566 million. The field of electronic communications includes:

- Internet networks of fixed operators.
- Radio networks of mobile operators.
- Trunk networks.
- Technical and related means of electronic communications.

Table 6. Estimation of direct losses of digital infrastructure due to war

Types of losses	Number of objects	Number of damaged objects	Loss assessment, million dollars
Damaged, unit			
- operators of fixed communication	4162	726	more than 300
- mobile operators	-	-	more than 200
Total direct losses of the industry	-	-	about 600

Source: (Ministry of Digital Transformation)

Determining the cost of damages for the owners of the infrastructure of electronic communication networks or its components (including objects of unfinished construction) of different categories is different. The following classification is used for these needs:

- National companies and electronic communications operators that provide electronic communication services to citizens of Ukraine throughout its territory. For national companies, direct losses are determined based on the results of inspection/survey of destroyed or damaged electronic communication network infrastructure facilities, if access is available (even if possible in officially uncontrolled territories). The amount of damage is determined in natural units (km, units, etc.) and is also estimated in money based on an approximate estimate of the cost of restoration work.
- Mediums that provide electronic communication services in several areas. For medium and small companies, direct losses are calculated through the estimated cost of restoration/reconstruction of networks or the average subscription fee for 24 months.
- Small, providing electronic communication services within the region.

Several things could be improved. Operators whose networks are completely or, for the most part, located in the occupation or the combat zone support the networks so that the citizens of Ukraine continue to use access to the Internet from the free territory. In this case, incomes are close to zero, and expenses remain.

At the same time, some of these operators have loans from banks. They cannot pay for the loan's use and repay the loan's body. At the same time, banks charge penalties for overdue payments and submit them to credit bureaus as improper borrowers.

The demand for access to high-speed Internet is growing worldwide and in Ukraine. The needs of society are changing - increasingly, the use of stationary and mobile digital devices, e-learning, receiving medical video services, interaction with state institutions, the use of various automated systems, etc., dramatically affects the volume and speed of data transmission.

Considering the listed positive factors, we should not forget certain shortcomings of digitization in Ukraine. First, we have a pronounced gap between the city and the village in the penetration of high-speed Internet - about 30%. About a third of the rural population (33-35%) did not have access to high-speed Internet even before the war, but under certain conditions, they could connect to it

because there are no market barriers, but there are technical barriers - the lack of an opportunity to connect, that is, there is the gap between demand and technical supply of Internet connection. The specialists' data show that provided infrastructure is created in rural areas, the indicated indicators of cities and villages can potentially be almost equal.

However, studies show that for vulnerable consumers, such as low-income families, pensioners, and disabled people, who have meager incomes, the Internet, especially high-speed, is not generally available to the public, regardless of the city or town. It is also worth noting that the level of education of Ukrainians largely determines the availability of high-speed Internet at home. According to research, 54% of people with an average education level do not need high-speed Internet access. This gap points to the need to implement programs to acquire digital skills, which have become vital in today's world.

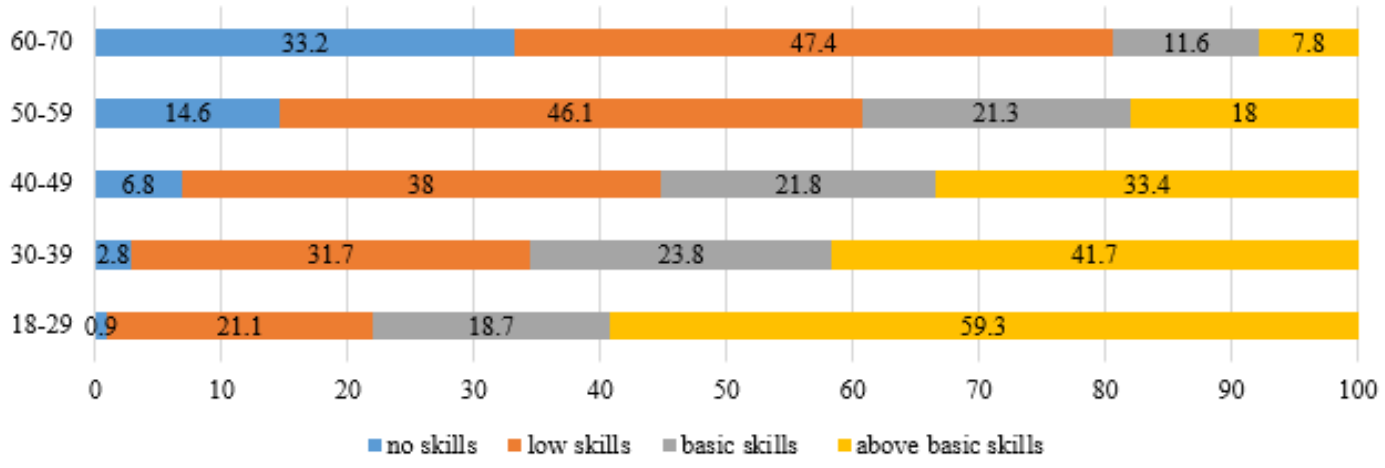
Studies of the state of providing social facilities with high-speed Internet showed that, for example, of the total number of healthcare facilities in Ukraine in 2019, less than 1% of them were connected to high-speed Internet. That is, the gap between hospitals is 99%. That is, the citizens of Ukraine need the opportunity to satisfy their own needs in digital medical services. This leads to unequal access to quality medicine, although Article 49 of the Constitution of Ukraine obliges the state to create conditions for effective and accessible medical care for all citizens. In secondary schools, the rate of access to high-speed Internet is only about 47%; that is, these are schools that have sufficient channel bandwidth to transport the load within the educational process using digital content, and the other 53%, which is 10,067 schools, have no connection at all to the Internet.

Thus, it becomes evident that in addition to ensuring the technical possibility of access to high-speed Internet for every citizen of the country, the population's digital skills are of primary importance. The Ministry of Digital Transformation of Ukraine conducted a national survey in 2019 and 2021 to establish the level of digital skills of the population of Ukraine according to the methodology for assessing digital skills, which the European Commission uses. According to the results of the mentioned study, a positive trend was noted; that is, the digital skills of the population of Ukraine increased significantly.

Thus, in 2019, 53% of the population of Ukraine had digital skills below the basic level, while a repeat survey in 2021 showed a gradual increase in digital skills (Fig. 9.).

In addition, the share of citizens with digital skills below the basic level decreased by 1.42 million people, i.e., by 5.2%, and currently stands at 47.8%. Also, the share of Ukrainians without digital skills decreased by 1.09 million, i.e., by 4%.

Figure 9. Analysis of digital skills by age



Source: (Ministry of Digital Transformation)

It was also found that it is possible to single out certain specifics of digital skills: both in 2019 and 2021, Ukrainians have the most communication and information skills - at a level higher than basic skills - 79.2% and 78.9%, respectively. While solving life problems and creating digital content was

and remained the least mastered by Ukrainians - at a level above the basic skills possessed by 55.8% and 36.8% of citizens, respectively.

Digital skills in Ukraine vary by age (Fig. 9).

Younger generations, particularly young people and teenagers aged 18-29, have the highest level of digital literacy. They have a primary computer, Internet, social media, and mobile skills. Studies have shown that 59.3% of respondents have digital skills at the level of "above basic skills," 18.7% at the level of "basic skills," 21.1% - "low skills," and less than 1% have no digital skills at all.

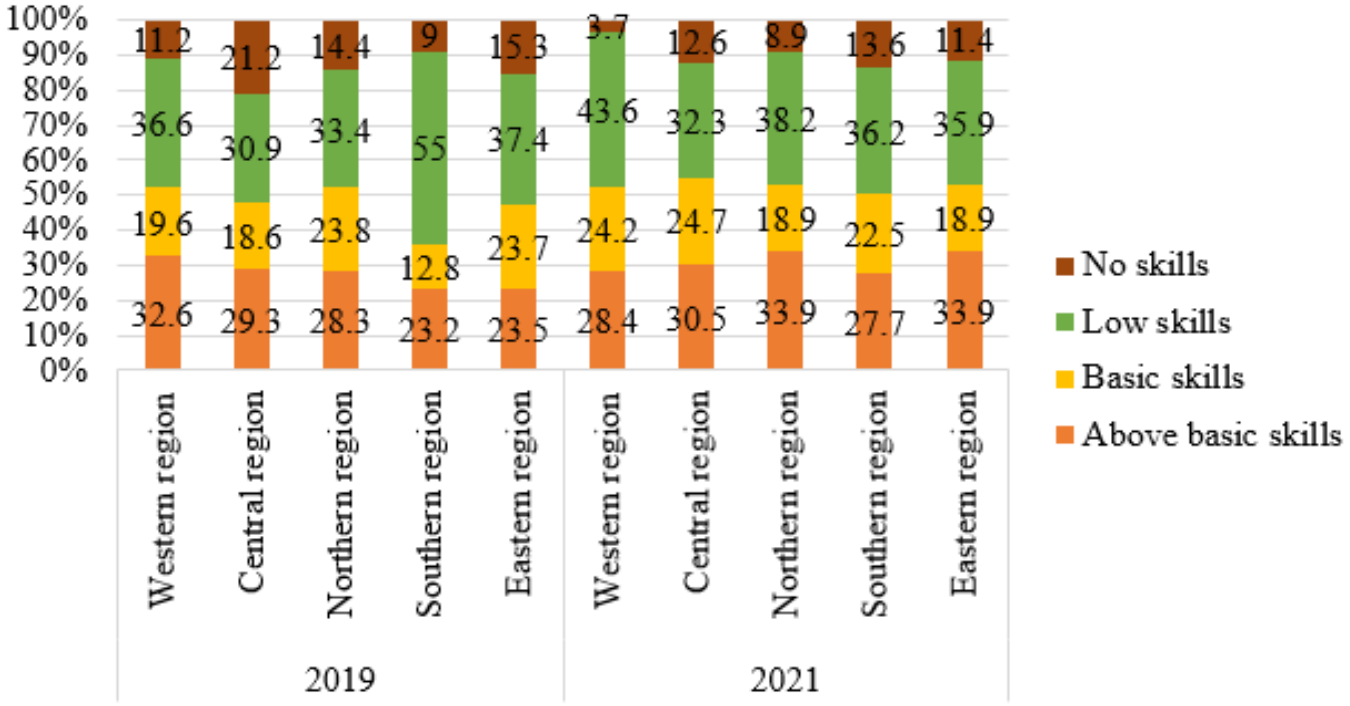
In middle-aged people (30-49 years old), digital skills can be different. Some have a sufficient level of literacy, especially those who actively use computers at work or in their personal lives. However, others may need more field experience and additional training. Thus, in the age group of 30-39 years, only about 3% do not have digital skills, and in the age group of 40-49 years, this indicator increases to almost 7%.

Older generations, the elderly, have a lower level of digital literacy. They need to be more confident in working with computers and the Internet. However, there is a trend toward an increasing interest and involvement of the older generation in learning digital skills, primarily to communicate with family and access information. Among the age group of 50-59 years, 14.6% of the population do not have digitalization skills, while in the age group of 60-70 years, this indicator increases by more than two times.

Ukraine is improving its education system and providing digital skills training at various levels of education. Such measures improve digital literacy in all age groups of the population. However, it is essential to continue to develop digital literacy programs and ensure access to digital technologies in all regions of the country.

The analysis of digital skills by region of Ukraine is shown in fig. 10.

Figure 10. Analysis of digital skills by regions of Ukraine



Source: (Ministry of Digital Transformation)

The Western region includes Volyn, Zakarpattia, Ivano-Frankivsk, Lviv, Rivne, Ternopil, Khmelnytskyi, and Chernivtsi regions; the central region - Vinnytsia, Kirovohrad, Poltava, Cherkasy regions; to the north - Zhytomyr, Kyiv, Sumy, Chernihiv regions and the city of Kyiv; to the southern region - Odesa, Mykolaiv, Kherson regions; to the eastern region - Dnipropetrovsk, Donetsk, Zaporizhia, Luhansk, Kharkiv regions.

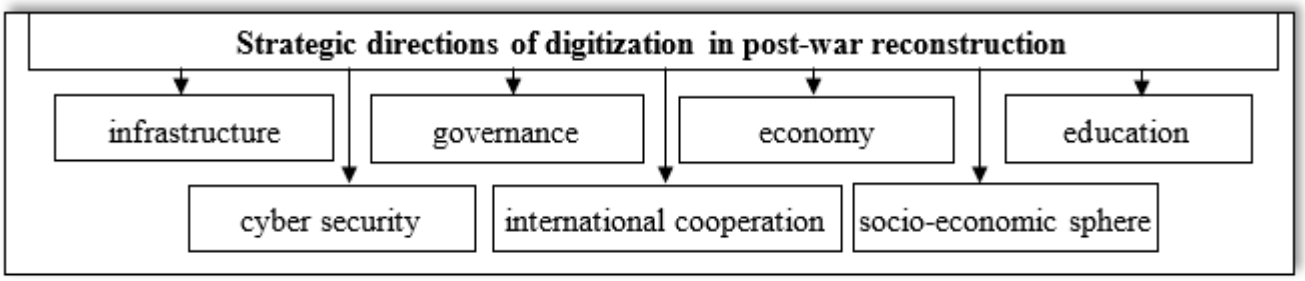
As for the regional level of digitization, it should be noted that there is a digital gap in providing the regions of Ukraine with access to the Internet: Kyiv has the highest level of entry in the country - 84% of households, on the other hand, Rivne Oblast is the region with the lowest level of Internet access, where only 49% of residents had access to broadband services.

Regarding digitizing public administration, Ukraine has a robust administrative service delivery system that includes innovative electronic tools for service delivery, but the war creates severe challenges in this area. The network of administrative service centers across the country remained primarily functional and operational in conjunction with work on the Diya digital application. Both are based on a well-developed catalog of services, which allows you to maintain the level of service provision: existing changed or even the creation of new ones. However, it is not without serious problems, such as large-scale hacking attacks that aim to destroy administrative data, mobilization or migration that causes a shortage of workers, which in turn leads to a decrease in the capacity of service providers and difficulties in accessing digital services due to border, etc.

Ukraine's digital economy is at a high level and developed rapidly both before and after the war, as the Ministry of Digital Transformation and the Ukrainian IT community accelerated their efforts. Thus, the IT sector in the first quarter of 2022 provided export revenue of 2 billion US dollars, which is 28% more compared to the previous year. Also, the number of Ukrainians employed in the IT industry increased from 200,000 to 250,000. The war caused severe disruptions in the sector, but increased international attention could open significant opportunities for future development.

As a result of the conflict in Ukraine, attention has been drawn to the need for digital identification solutions: displaced persons often lose access to their physical documents. At the same time, there is an urgent need to confirm their identification data in host countries. If the war continues, the focus must be on keeping businesses and citizens connected to the Internet and modernizing the communications and infrastructure of public services. Digital technologies should become a critical factor in Ukraine's post-war recovery. The strategic directions of digitization that will contribute to the post-war recovery of Ukraine's economy are shown in fig. 11.

Figure 11. Strategic directions of digitization in post-war reconstruction



Source: authors` development

6.DISCUSSION

The debatable points of the research topic are due to uncertain conditions: the unknown duration of the war and the destruction's consequences, there may be completely different scenarios of the development of events and other aspects. The authors will analyze the state of digitization of Ukraine before the war and the intermediate consequences of the destruction; however, the war is still ongoing, new, and new factors of destruction and damage become known every day, so the topic will require further research.

Studies of ways to approach the European future for Ukraine have shown that one of the most critical aspects is education, particularly acquiring digital skills, which confirms the scientific work of Lamberti G., Lopez-Sintas J., & Sukphan J. (2021). Additionally, the impact of open data and information management practices at the government level should not be underestimated. In the conditions of the post-war recovery of the country, it is worth adapting them to the requirements of the European Union, implementing the best practices to ensure the fastest and most effective recovery

of the Ukrainian economy and society and a transparent process of using international aid for the recovery of Ukraine.

Agreeing with Senyo P. K., Effah J., & Osabutey E. L. (2021), it is worth noting the importance of digitization of public administration. Thus, the Diya application introduced in Ukraine is gradually becoming a super app - a single window of communication with the state- a universal application where you can get all state services and services that people need from birth and throughout their lives. In particular, the mentioned application satisfies the need for digital identification of the individual, the importance of which is emphasized in his research by Seifert R. (2020).

Today's indicators in the IT industry of Ukraine are much better than in other sectors, mainly due to its mobility, portability, and ability to work remotely. For example, according to the NBU, in the 1st quarter of 2022, the IT industry provided a record quarterly export of $2 billion for all of its existence. That is, it was possible to save 95% of contracts. It is building on the research conducted by Hadjielias E., Dada O. L., Cruz A. D., Zekas S., Christofi M., & Sakka G. (2021) and agreeing with the thesis about the importance of developing organizations that ensure the implementation of digital technologies. Thus, while the country is rebuilding, the IT industry can ensure its economic stability. But for this, you need a concrete plan for supporting the industry, which it needs for development.

7. CONCLUSIONS

In the conditions of digital transformation, each country determines the priority directions for forming strategic development goals. Studies have shown that Ukraine's digitization level is relatively high in the pre-war period and during the war. However, the war caused a series of destructions and damages that greatly complicated the functioning of this system. There is a question of finding ways to restore the country, and one of them is the digitization of strategic areas, including the economy, public administration, infrastructure, education, international integration of the digital sphere, and others. Much has already been done in this direction, but more is needed; as the war continues, the country suffers even more loss and damage, resources are reduced, and the challenges become more difficult to overcome. Studies have confirmed that the reduction in the level of digital inequality has a high correlation with the growth of digitalization. In addition, the development of the level of digitalization is directly proportional to the efficiency of the IT industry. Therefore, special attention should be paid to these aspects: to increase citizens' digital literacy and the IT sphere's development. In the face of the apparent need to build damaged roads, the possibility of laying fiber optic cables and connecting more people should be considered, even if the operators cannot provide service for several years, including in rural areas. The already sufficiently advanced Diya electronic services platform also needs further development; in 3 years, 14 digital documents and more than 25 services have been launched in the application.

As a result of the research, we proposed our own systematic approach to calculating the integral coefficient of digitalization of Ukrainian society, which is based on five sub-indices, three of which are used from universally recognized world coefficients, and two are proposed to be calculated from partial indices according to our own author's methodology. Based on the calculations, a close relationship between the considered sub-indices was revealed based on the values of the correlation matrix - the highest relationship was found between digital business and e-government. In addition, it was established that Ukraine has lower values in comparison with other countries of the world than other sub-indices and a lower level was found for infrastructure components, where Ukraine approaches the lower quartile of the spread of values. In addition, the infrastructure sub-index also has a close correlation with digital business and e-government. Thus, the primary efforts to increase the development of the digital society in the post-war period should be directed at improving the functioning mechanisms of the electronic government and financing the creation of the corresponding infrastructure.

REFERENCES

Ariyanto, D., Soejono, F., & Dewi, S. P. (2020). Digital economy and financial inclusion. *Journal of Environmental Treatment Techniques*, 8(1), 241-245. https://www.academia.edu/81757375/Digital_Economy_and_Financial_Inclusion?f_ri=30855

Bonina, C., Koskinen, K., Eaton, B., & Gawer, A. (2021). Digital platforms for development: Foundations and research agenda. I*nformation Systems Journal*, 31(6), 869-902. https://onlinelibrary.wiley.com/doi/full/10.1111/isj.12326

Bulturbayevich, M. B., & Jurayevich, M. B. (2020). The impact of the digital economy on economic growth. *International Journal of Business, Law, and Education*, 1(1), 4-7. https://ijble.com/index.php/journal/article/view/2

Chinoracky, R., Kurotova, J., & Janoskova, P. (2021). Measuring the impact of digital technologies on transport industry–macroeconomic perspective. *Transportation Research Procedia*, 55, 434-441. https://doi.org/10.1016/j.trpro.2021.07.092

DataReportal. https://datareportal.com/about

Geng, Zhechen & He, Guosheng. (2021). Digital Financial Inclusion and Sustainable Employment: Evidence from Countries along the Belt and Road. Borsa Istanbul Review. 21. 10.1016/j.bir.2021.04.004. https://www.sciencedirect.com/science/article/pii/S221484502100034X

Đukić, P. (2018). Innovative economy in the light of the reforms and business modernization. *ECONOMICS – Innovative and Economics Research Journal*, 6(1), 45–61. https://doi.org/10.2478/eoik-2018-0002

Mićić, L., & Mastilo, Z. (2022). Digital workplace transformation: innovative approach after Covid-19 pandemic. *ECONOMICS – Innovative and Economics Research Journal*. 10(2), 63-76. https://doi.org/10.2478/eoik-2022-0014

Mašić, B.,Vladušić, L., Nešić, S. (2018). Challenges in creating transformative growth for companies in digital economy. *ECONOMICS – Innovative and Economics Research Journal,* 6(2), 37-48. https://doi.org/10.2478/eoik-2018-0024

Hadjielias, E., Dada, O. L., Cruz, A. D., Zekas, S., Christofi, M., & Sakka, G. (2021). How do digital innovation teams function? Understanding the team cognition-process nexus within the context of digital transformation. *Journal of Business Research*, 122, 373-386. https://ideas.repec.org/a/eee/jbrese/v122y2021icp373-386.html

Hammer, M., Scheiter, K., & Stürmer, K. (2021). New technology, new role of parents: How parents' beliefs and behavior affect students' digital media self-efficacy. *Computers in Human Behavior*, 116. https://doi.org/10.1016/j.chb.2020.106642

Hastie T., Tibshirani R., Friedman J. (2001). The Elements of Statistical Learning. Springer. https://hastie.su.domains/Papers/ESLII.pdf

Hootsuite. https://www.hootsuite.com

Hung, B. Q., & Nham, N. T. H. (2023). The importance of digitalization in powering environmental innovation performance of European countries. *Journal of Innovation & Knowledge*, 8(1). https://doi.org/10.1016/j.jik.2022.100284

Jacobson, N. C., & Nemesure, M. D. (2021). Using artificial intelligence to predict change in depression and anxiety symptoms in a digital intervention: evidence from a transdiagnostic randomized controlled trial. *Psychiatry research*, 295. https://doi.org/10.1016/j.psychres.2020.113618

Kim, D., Long, Y., Zhao, Y., Zhou, S., & Alexander, J. (2021). Teacher professional identity development through digital stories. *Computers & Education*, 162. https://www.academia.edu/44944050/Teacher_professional_identity_development_through_digital_stories

Klebanova, T., Hur'ianova, L., Chahovets', L., Panasenko, O., Serhiienko, O., Yatsenko, R. (2020). Business analytics of multidimensional processes. KhNEU im. S. Kuznetsia. http://ebooks.git-elt.hneu.edu.ua/babap/about.html

Kyiv School of Economics. (2023). https://kse.ua/

Lamberti, G., Lopez-Sintas, J., & Sukphan, J. (2021). The social process of internet appropriation: Living in a digitally advanced country benefits less well-educated Europeans. *Telecommunications Policy*, 45(1). https://doi.org/10.1016/j.telpol.2020.102055

Matarazzo, M., Penco, L., Profumo, G., & Quaglia, R. (2021). Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective. *Journal of Business Research*, 123, 642-656. https://doi.org/10.1016/j.jbusres.2020.10.033

Ministry of Digital Transformation. (2023). https://thedigital.gov.ua/

Parmar, R., Leiponen, A., & Thomas, L. D. (2020). Building an organizational digital twin. B*usiness Horizons*, 63(6), 725-736. https://doi.org/10.1016/j.bushor.2020.08.001

Peng, Y., & Tao, C. (2022). Can digital transformation promote enterprise performance?—From the perspective of public policy and innovation. *Journal of Innovation & Knowledge*, 7(3). https://doi.org/10.1016/j.jik.2022.100198

Pershina, Raissa & Soppe, Birthe & Thune, Taran. (2019). Bridging analog and digital expertise: Cross-domain collaboration and boundary-spanning tools in the creation of digital innovation. *Research Policy*, 48. https://doi.org/10.1016/j.respol.2019.103819

Plyuta V. (1980). Comparative analysis in economic studies. Methods of taxonomy and factor analysis / Trans. from Polish V. V. Ivanov, scientific editor V. I. Zhukovsky. M.: Statistics. 152. https://www.twirpx.com/file/108986/

Seifert, R. (2020). Digital identities–self-sovereignty and blockchain are the keys to success. *Network Security*, 2020(11), 17-19. https://doi.org/10.1016/S1353-4858(20)30131-8

Senyo, P. K., Effah, J., & Osabutey, E. L. (2021). Digital platformisation as public sector transformation strategy: A case of Ghana's paperless port. *Technological Forecasting and Social Change*, 162. https://doi.org/10.1016/j.techfore.2020.120387

Shakina, E., Parshakov, P., & Alsufiev, A. (2021). Rethinking the corporate digital divide: The complementarity of technologies and the demand for digital skills. *Technological Forecasting and Social Change*, 162. https://doi.org/10.1016/j.techfore.2020.120405

Sneath, P.H. and Sokal, R.R. (1973) Numerical Taxonomy: The Principles and Practice of Numerical Classification. 1st Edition, W. H. Freeman, San Francisco. https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/ReferencesPapers.aspx?ReferenceID=1229485

Ward Jr., J.H. (1963) Hierarchical Grouping to Optimize an Objective Function. *Journal of the American Statistical Association*, 58, 236-244. https://doi.org/10.1080/01621459.1963.10500845

We Are Social. https://wearesocial.com/uk/

Williams FD, Watanabe-Kanno GA, Williams FE, Arriola-Guillén LE. Correlation of two different measuring methods for digital models: Manual on printed paper and digital in computer: A retrospective study. *J World Fed Orthod*. 2021 Jun;10(2):74-78. https://doi.org/10.1016/j.ejwf.2021.03.001

Zhao, T., Jiao, F., & Wang, Z. . (2023). Digital economy, entrepreneurial activity, and common prosperity: Evidence from China. *Journal of Information Economics*, *1*(1), 59–71. https://doi.org/10.58567/jie01010005; https://anser.press/index.php/jie/article/view/143