Ukraine on the Road to the European Digital Market: Status and Tools for Implementing the European Digital Economy and Society Index in Ukraine

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Abstract

Successful development of the digital economy and society in any country requires appropriate public policy and public administration, which should be based on quality, reliable, accurate, timely, complete information, as well as the ability to compare their effectiveness and efficiency in other countries, including by applying international ratings and indices. The article analyzed the most famous rating indices. The relevance and necessity of implementing the digital economy and society index (DESI) in Ukraine is substantiated, and the main problems of its implementation are highlighted. The main prerequisites and organizational and legal mechanisms of its implementation are described. It has been proven that joining Ukraine to DESI will provide an opportunity to measure the state's own progress and reflect its objective place in world rankings. In addition, DESI information is extremely important and useful for attracting international investors and confirms the state's compliance with global trends and world challenges. The future work will be directed to experimental study of some DESI indicators and factors, that influence on these. It can be studied for both EU states and Ukraine as well as strategy for Ukraine can be created and implemented.

Keywords 1

Digital economy, indices, global indicators, international rankings, Digital Economy and Society Index (DESI), methodology

1. Introduction

Successful development of the digital economy and society in any country requires appropriate public policy and public administration, which should be based on quality, reliable, accurate, timely, complete information, as well as the ability to compare their effectiveness and efficiency in other countries, including by applying international ratings and indices.

At the international level, in order to compare the dynamics of digital economy and society, different rating indices are used, each of which is designed to highlight a particular aspect of these processes, uses a specific methodology, data sets and sources, users.

For a more objective and comprehensive view of the country's place in these processes compared to other countries, experts usually use a set of several global indicators for analysis and evaluation, the

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results of which can be an important factor and incentive to improve public policy and administration, introduction of the best international experience.

Among these global indicators, the most well-known and used are the following [1]:

- ICT Development Index (IDI);
- Digital Economy and Society Index (DESI);
- Digital Evolution Index (DEI);
- IMD World Digital Competitiveness Index (WDCI);
- Networked Readiness Index (NRI);
- BCG Economic Digitization Index (e-Intensity);
- Digital Adoption Index (DAI);
- Global Innovation Index (GII), etc.

For the convenience of analysis, some experts divide these global indicators into two conditional groups: the first group includes IDI, DESI and e-Intensity indicators, which have a greater social focus and reflect the socio-economic integration of society and do not take into account the digital transformation of business and industry, trade, etc., as well as the second group of indicators DEI, WDCR and NRI, which to a greater extent combine institutional, economic and technological indicators that reflect the development of regulatory and research base, the use of ICT in business and information security [1].

The popularity of the above digitization indices and the representation of Ukraine in them are presented in the form of a table 1 [2]:

Table 1

Analysis of rating indices of digitalization and representation of Ukraine in them

Index name	The popularity of the index (number of mentions in Google), thousand units	Representation Of Ukraine (+;-)	Period representation of our states (from which year)
1. Digital Economy Index and society – DESI	107 000	-	-
2. Digital Evolution Index – DEI	173 000	-	-
3. Digital Adoption Index – DAI	191 000	+	since 2014
4. ICT Development Index – IDI	70 700	+	since 2002
5. Global Innovation Index – GII	457 000	+	since 2007
6. Networked Readiness Index – NRI	897	+	since 2002
7. Boston Consulting Group – e-Intensity	7 990	+	since 2011
8. World Digital Competiveness Index – WDCI	16 600	+	since 2014

Improving the level of completeness and objectification of analysis, assessment, identification of trends and forecasts of the country's development, as noted above, involves the integrated use of the above indicators, especially in the formation and implementation of public policy in this area, including the development of conceptual and strategic documents. According to Table 1, the implementation of the DESI in Ukraine is considered the relevant and necessary. So, the purpose of this article: to analyze Ukraine's readiness to implement of the DESI and to substantiate the organizational and legal mechanism (scientific and methodological approaches) for its implementation.

2. Implementation of DESI in Ukraine

Despite the announced course for Ukraine's integration into the EU's single digital market, DESI, which has been monitored by the European Commission since 2014 based on DESI and DEI reports, was not popular in Ukraine until 2021.

In addition, Ukraine was not represented in the reports and did not use them in the main strategic and conceptual documents to measure its own progress in the field of digital productivity and to compare with the economies of other countries.

The situation has changed with the adoption and adoption in 2022 of two Laws of Ukraine "On Electronic Communications" and "On the National Commission for State Regulation of Electronic Communications, Radio Frequency Spectrum and Provision of Postal Services", which identifies the need carrying out measurements by the regulatory body in the interests of forming the DESI Index. The problem of implementation of the DESI Index in Ukraine has recently become more relevant in connection with the possibility of accelerated accession of our country to the EU.

According to a study conducted by international experts, the main problems of implementing the DESI in Ukraine are highlighted:

- the national government statistical system does not currently provide all the statistics needed for DESI;
- low quality of data collected;
- no government bodies responsible for digital performance monitoring and data collection for DESI;
- no coordination between government agencies involved;
- data collected by other agencies except the State Statistics Service of Ukraine are not considered statistics;
- there is no necessary financial, organizational, legal, methodological support [3].

At the same time, Ukraine's participation in the formation and presented in these indices allows not only to obtain an objective assessment of its place in global trends (Fig. 1), but is extremely important information for international investors, confirming its commitment to the principles of openness and transparency commitment.

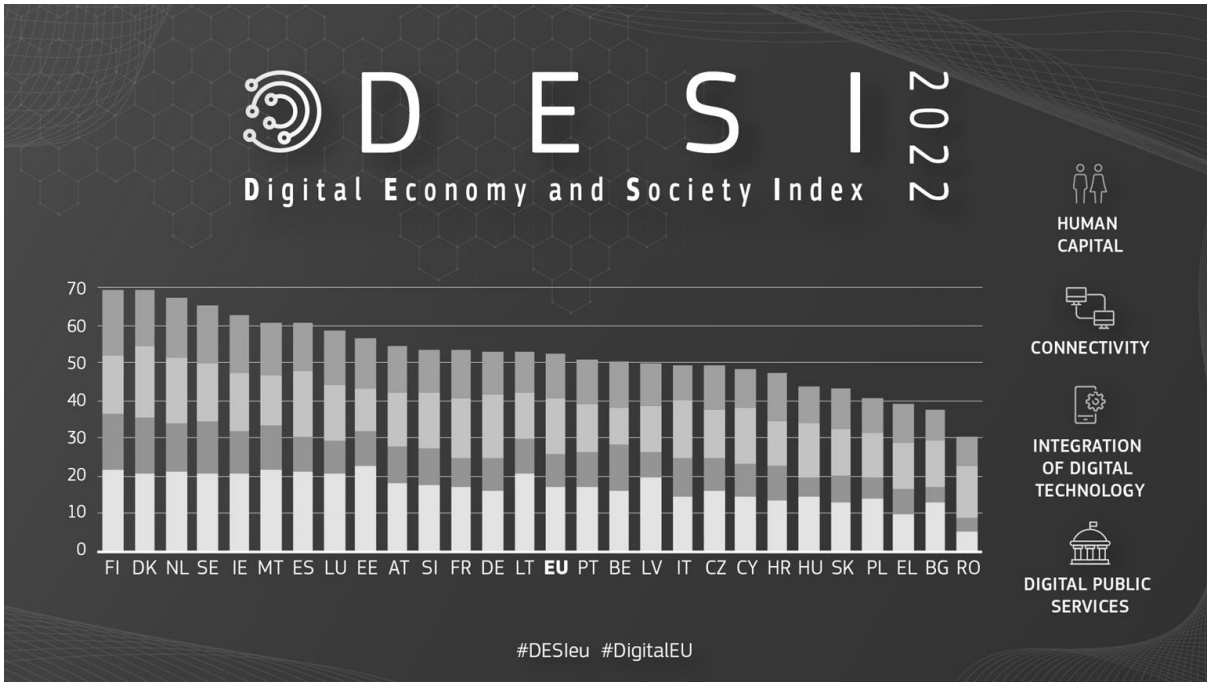

Figure 1: Performance indicators of digital technologies in Europe according to the DESI index

Participation in DESI will allow Ukraine to enter the digital single market, in particular to harmonize its statistical system with EU standards and practices in accordance with Art. 355 and Annex XXIX of the Association Agreement between Ukraine, of the one part, and the European Union, the European Atomic Energy Community and their Member States, of the other part, to identify areas where it lags behind, adjust its policies and improve governance, including by "adopting a strategy for the development of electronic communications, the national plan for the development of electronic broadband electronic communications networks, programs, concepts aimed at achieving the goals and objectives set by law, as well as forecasts for the development of electronic networks and services" [4].

The main purpose of the DESI is to assess the progress of each country in achieving the goals of the digital economy in the European Union and to monitor the state of digital development of individual member states.

The index analyzes 37 indicators from 5 sub-indexes (key sets), presented in Fig. 2:

- connectivity (connectivity / collectivity – study of deployment and use of fixed and mobile broadband access),
- human capital (digital skills),
- use of Internet services by the population,
- integration of digital technologies by business,
- digital public services, which include ICT research and development as an additional sixth set.

Dimension	Sub-dimension	Indicator
1 Human capital	1a Internet user skills	1a1 At least basic digital skills
		1a2 Above basic digital skills
		1a3 At least basic digital content creation skills
	1b Advanced skills and development	1b1 ICT specialists
		1b2 Female ICT specialists
		1b3 Enterprises providing ICT training
		1b4 ICT graduates
2 Connectivity	2a Fixed broadband take-up	2a1 Overall fixed broadband take-up
		2a2 At least 100 Mbps fixed broadband take-up
		2a3 At least 1 Gbps take-up
	2b Fixed broadband coverage	2b1 Fast broadband (NGA) coverage
		2b2 Fixed Very High Capacity Network (VHCN) coverage
	2c Mobile broadband	2c1 5G spectrum
		2c2 5G coverage
		2c3 Mobile broadband take-up
	2d Broadband prices	2d1 Broadband price index
3 Integration of digital technology	3a Digital intensity	3a1 SMEs with at least a basic level of digital intensity
	3b Digital technologies for businesses	3b1 Electronic information sharing
		3b2 Social media
		3b3 Big data
		3b4 Cloud
		3b5 AI
		3b6 ICT for environmental sustainability
		3b7 e-Invoices
	3c e-Commerce	3c1 SMEs selling online
		3c2 e-Commerce turnover
		3c3 Selling online cross-border
4 Digital public services	4a e-Government	4a1 e-Government users
		4a2 Pre-filled forms
		4a3 Digital public services for citizens
		4a4 Digital public services for businesses
		4a5 Open data

Figure 2: DESI methodology [8]

The overall DESI index (max and min indicators amounts are presented in Fig. 3), calculated as the weighted average of the five main dimensions of DESI: connectivity – 25%, digital skills – 25%, Internet use – 15%, digital integration – 20% and public digital services – 15% (Fig. 4). The value of each dimension reflects the priorities of EU digital policy. The dimensions of "Connectivity" and "Human Capital" are considered the most relevant, as they represent the infrastructure of the digital economy and society [3].

Data for these six sets are collected from four main sources: households, enterprises, telecoms regulators, data on digital government services and the ICT market (summarized from government statistics and government). Based on them, since 2014, annual reports on the progress of digital transformations in Europe are formed and published.

Indicator	Minima	Maxima
1a1 At least basic digital skills	0%	100%
1a2 Above basic digital skills	0%	66%
1a3 At least digital content creation skills	25%	100%
1b1 ICT specialists	0%	10%
1b2 Female ICT specialists	0%	50%
1b3 Enterprises providing ICT training	0%	50%
1b4 ICT graduates	0%	10%
2a1 Overall fixed broadband take-up	50%	100%
2a2 At least 100 Mbps fixed broadband take-up	0%	100%
2a3 At least 1 Gbps take-up	0%	50%
2b1 Fast broadband (NGA) coverage	25%	100%
2b2 Fixed Very High Capacity Network (VHCN) coverage	0%	100%
2b3 Fibre to the Premises (FTTP) coverage	0%	100%
2c1 5G spectrum	0%	100%
2c2 5G coverage	0%	100%
2c3 Mobile broadband take-up	25%	100%
2d1 Broadband price index	25	100
3a1 SMEs with at least a basic level of digital intensity	20%	100%
3b1 Electronic information sharing	0%	60%
3b2 Social media	0%	60%
3b3 Big data	0%	75%
3b4 Cloud	0%	75%
3b5 AI	0%	75%
3b6 ICT for environmental sustainability	30%	100%
3b7 e-Invoices	0%	100%
3c1 SMEs selling online	0%	50%
3c2 e-Commerce turnover	0%	33%
3c3 Selling online cross-border	0%	25%
4a1 e-Government users	0%	100%
4a2 Pre-filled forms	0	100
4a3 Digital public services for citizens	35	100
4a4 Digital public services for businesses	40	100
4a5 Open data	0%	100%

Figure 3: Max and min indicators in DESI methodology

The annual analysis of Eurostat data identifies priority areas of the digital economy in the Member States that require concrete action and investment, and the necessary policy decisions. Following its adoption in 2020 [5], DESI reports have become an important source of information on the success of this strategic document.

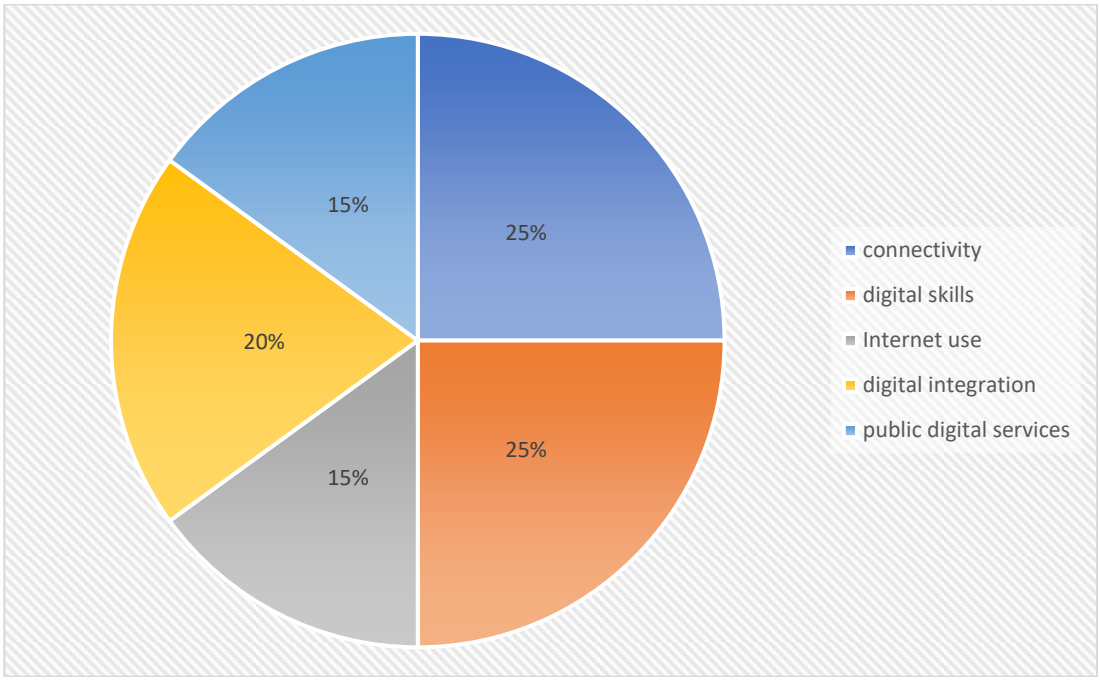

Figure 4: The main parameters of DESI

The European Commission also compares the results of member countries with the results of 17 other countries outside the EU (Australia, Brazil, Canada, Chile, China, Iceland, Israel, Japan, South Korea, Mexico, New Zealand, Norway, Russia, Serbia, Switzerland, Turkey and the United States). I-DESI (International Index of Digital Economy and Society) has been developed for comparison with countries outside the European Union. The main source of data for the calculation of the DESI Index are Eurostat databases, and ITU and UN databases are also used. The DESI index is calculated as a composite index that summarizes various indicators of digital development and tracks the evolution of EU countries in terms of their digital competitiveness. The advantage of this index is that it includes the level of integration of digital technologies with business and government, which gives some idea of the state of digital transformation of the economy [1].

The information needed to calculate the indexes is either accumulated on the basis of one of the state bodies, or distributed among various state institutions and requires its additional consolidation. Therefore, for the second case, which today includes Ukraine, the problem of rational definition of the set of internal sources of information and the procedure for obtaining it, requirements for inventory and data quality, appointment of a national coordinator for collection, verification, consolidation, systematization, pre-processing, accumulation is extremely important. These data with the simultaneous assignment of the functions of a communicator with the relevant international organizations.

The implementation of the Index in Ukraine implies Ukraine’s readiness to collect and provide data needed by the EU, as well as the EU’s readiness to facilitate Ukraine’s accession to the DESI framework, due to the DESI statistical system as an integral part of the EU digital economy, i.e. ecosystems.

Joining DESI will allow Ukraine to measure its own progress together with EU member states and possibly other member states, as well as to meet global trends and challenges.

The main prerequisites for Ukraine's readiness to join the DESI framework are [3]:

- the coordinator and other participants should be appointed at the legislative level;
- establishing proper coordination and interagency communication;

- the volume of key indicators and additional specific national indicators should be jointly agreed and periodically reviewed;
- collected data must be reliable, they should be in line with Eurostat methodology and practice;
- it is necessary to confirm the institutional (personnel and financial) ability to conduct periodic observations of DESI;
- implement technical tools for online observations and aggregate data.

The Ministry of Digital Transformation of Ukraine (Ministry of Figures), the National Commission for State Regulation of Electronic Communications, Radio Frequency Spectrum and Postal Services (Regulatory Body – NCEC) and the State Statistics Service of Ukraine (State Statistics Committee) are proposed to be the main Ukrainian institutions responsible for creating the DESI framework. In our opinion, the Ministry of Economic Development, the Ministry of Education and Science of Ukraine ("digital skills" of civil servants) and the National Agency of Ukraine for Civil Service Affairs (form a sub-index "digital skills") should also be added to this list. Given the aggregate structure of the DESI Index and the statutory powers of the NCEC, it can be stated that the regulatory body NCEC should be responsible only for collecting and providing information on only one of the sub-indices, namely connection (connectivity) to other interested organizations, institutions and bodies, international institutions, including the institutions of the European Union "[4]. The other 5 DESI sub-indices should be formed, first of all, by the Ministry of Finance, the Ministry of Economic Development, the Ministry of Education, the National Agency of Ukraine for Civil Service Affairs and the State Statistics Committee (Fig. 5).

When defining the national I-DECI system in Ukraine, it should be borne in mind that there are no specific EU acts or guidelines for DECI on the collection of DESI indicators (in particular, the "Connectivity" dimension). There are only a few documents and methodologies of the Communications Committee (COCOM) on data processing that can better understand the results and identify data sources at EU level. For example, Eurostat, together with the EU and OECD countries, annually develops draft decisions taking into account the changing needs of users and policy makers and makes appropriate decisions on key indicators and a list of additional ones. Such observations are based on standard questionnaires and accompanying methodological guidelines for conducting surveys [3].

	Name	Market	Type	Valuation (billion USD)	Location
	Google	B2C	Deep tech Artificial intelligence	1 900	Mountain View United States
	Amazon	B2C **Home living** **Transportation** Logistics & delivery	Marketplace & Commerce	1700	Seattle United States
	Tesla Motors	B2C **Energy** **Transportation** Autonomous & sensor tech Clean energy Energy Storage	Artificial intelligence Autonomous & sensor tech Deep tech Selling own inventory Manufacturing	808.6	Palo Alto United States
	Nvidia	B2B, B2C **Gaming** Console & PC gaming	Machine learning Deep learning Artificial intelligence Deep tech Hardware	601.9	Santa Clara United States

Figure 5: Most valuable unicorns worldwide as of 2022.03.01 [9]

	Meta (Facebook)	B2C Media Social Media	Big data Artificial intelligence Advertising Saas	510.2	Menlo Park United States
	ByteDance	B2C Media Telecom Content production	Natural language processing Big data Deep tech Subscription	400.0	Beijing China
	Meituan	B2C Telecom Marketing Ecommerce solutions	Artificial intelligence Commission Marketplace & Commerce	360.3	Beijing China
	Alibaba	B2B Enterprise software	Marketplace & Commerce Saas	283.0	Huangzhou China
	Kuaishou	B2C Media Enterprise software Content production	Machine learning Artificial intelligence Advertising	214.0	Beijing China
	Salesforce	B2B Marketing Enterprise software CRM & sales	Artificial intelligence Subscription Saas	202.2	San Franciso United States
	Netflix	B2C Media Streaming	Machine learning Artificial intelligence Subsciption	182.6	Los Gatos United States
	BYD Company	B2C Energy Transportation Energy storage maintenance	Hardware Selling own inventory Manufacturing	155.9	Shenzhen China

Figure 6: Most valuable unicorns worldwide as of 2022.03.01 [9]

The urgency of determining the place and the role of the regulatory body in providing information for the calculation of the DESI is due to the requirements of national legislation [2,3] and the Association Agreement [4] on Ukraine's entry into the European digital market and lack of necessary national statistical surveys for effective and efficient public administration in the digital economy and society, including electronic communications and radio spectrum [6].

Thus, according to paragraph 8, part 1, Art. 9 of the Law of Ukraine "On Electronic Communications" regulatory authority "in accordance with its competence may require providers of electronic communications networks and / or services, users of the radio spectrum to provide written and / or electronic information related to the conditions of general authorization, the right to use radio frequency range and resources of numbering and in other cases provided by this Law, in particular for: providing information for statistical and other reports, in particular on the Digital Economy and Society Index (DESI), to other interested organizations, institutions and bodies, international institutions, including , institutions of the European Union ".

The powers of the regulatory body on this issue are more clearly, specifically and in detail defined in Article 4 of the Law of Ukraine "On the National Commission for State Regulation of Electronic Communications, Radio Frequency Spectrum and Provision of Postal Services" [7]: "3) request and obtain information, including from the financial authorities, for statistical and other reports, such as

the Digital Economy Index, from providers of electronic communications networks and services, spectrum users, numbering users and postal operators, and the executive, Society (DESI), with the right to provide such information to the relevant institutions of the European Union or other foreign and international organizations, national regulatory authorities of other states".

In order to collect and pre-process the information necessary to form a component of the "connectivity" of the DESI Index, the Regulator may develop and implement a separate procedure based on the Regulator's Methodology, or include a DESI Index questionnaire adapted to the specifics of electronic communications and radio spectrum Ukraine, as part of the Regulator's electronic reporting system (ERS) survey forms. Each of these two approaches has its disadvantages and advantages.

The implementation of the first approach requires more resources for its implementation, but is guaranteed to ensure the interoperability (interoperability) of the national electronic reporting system with the European reporting system according to the DESI Index.

According to the second approach, the Regulator is proposed to collect information to form a component of the "connectivity" of the DESI Index by using the Electronic Reporting System of the Regulator (ERS). At the same time, it is necessary, first of all, to ensure terminological, substantive and structural consistency of the indicators of the DESI Index questionnaires and the relevant forms of ERS reporting, to eliminate their possible duplication.

The analysis shows that some of the indicators of the DESI Index questionnaire may coincide in content with the corresponding indicators of ERS reporting forms, others require a separate additional inclusion in the structure of ERS reporting forms. At the same time, it is also important to agree on the timing of research, as electronic regulatory reporting is collected quarterly and annually, research on the DESI Index – once a year. In addition, it is necessary to take into account the instability of the structure of indicators by the DESI Index, which may change annually. The advantages of this approach are the availability of effective organizational, legal, informational, communicative mechanisms of public administration and administration of electronic regulatory reporting system, positive three years of experience in its operation by the Regulator, and a high level of automation of basic procedures and processes. In addition, such a combined form of survey (reporting) of indicators (electronic regulatory reporting system and DESI Index) will help save time and other resources, increase their reliability due to the existing correlations between some of them and gain additional opportunities for filtering inaccurate measurements. At the same time, the introduction of the second approach requires clear inter-component coordination of research between interested government agencies in order to ensure synchronization of research component "connectivity" with other components of the DESI Index, as well as electronic regulatory reporting of the Regulator.

Following the abolition by the State Statistics Committee at the end of 2019 of the quarterly state statistical survey № 14 "Report on the activities of operators, telecommunications and postal providers", data on telecommunications are collected only by NCEC and the State Statistics Service receives such data from NCEC under the agreement. However, such data cannot be formally considered statistical data, as the NCEC does not have the authority to collect and publish official statistics in accordance with the Law of Ukraine “On State Statistics”.

Until 2021, the State Statistics Service conducted only two types of surveys that could be used in the interests of the DESI Index:

- “The use of information and communication technologies in the enterprise” (annual form of state statistical observation 1-ICT);
- "Report on the use of e-democracy tools by public authorities and local governments" (annual form of state statistical survey № 1-ED), which was monitored in 2019 and 2020, but which in 2021 was abolished by the State Statistics Service.

Therefore, the State Statistics Service is an incomplete, unreliable source of information on the DESI Index and, as noted in [3]: “The State Statistics Service lacks funds, in particular for the organization of household surveys. The lack of qualified staff is assessed as a medium-sized problem. The State Statistics Service also does not have adequate IT systems for receiving data from respondents in electronic form, which is a prerequisite for the future storage and processing of such data by Eurostat. In addition, there are risks of misunderstanding of the questionnaires by enterprises and households, as methodological work with them was not carried out and the State Statistics Service

did not provide appropriate recommendations. A more comprehensive analysis is needed to verify the coverage of DESI data in the updated questionnaires.

3. Conclusion

The work analyzes the most well-known rating indices, including: ICT Development Index (IDI); Digital Economy and Society Index (DESI); Digital Evolution Index (DEI); IMD World Digital Competitiveness Index (WDCI); Network Readiness Index (NRI); BCG Economic Digitization Index (e-Intensity); Digital Adoption Index (DAI); Global Innovation Index (GII), etc.

The relevance of the implementation of the digital economy and society index (DESI) in Ukraine is substantiated, in connection with the possibility of our country's accelerated accession to the EU. The main purpose of which is to assess the progress of each country in achieving the goals of the digital economy in the European Union and to monitor the state of digital development of individual member states.

The main challenges of its DESI implementation are highlighted: the national public statistical system currently does not provide all the statistical data required for DESI, the low quality of the collected data, the lack of public authorities responsible for monitoring digital productivity and data collection for DESI, the lack of coordination between the public authorities involved, data , collected by other bodies, except the State Statistics Service of Ukraine, are not considered statistics, there is a lack of necessary financial, organizational, legal, methodological support.

The main prerequisites and organizational and legal mechanisms of its implementation are described. It has been proven that joining DESI will allow Ukraine to measure its own progress together with EU member states and possibly other member states, as well as respond to global trends and challenges. At the same time, Ukraine's participation in the formation and representation in these indices allows not only to obtain an objective assessment of its place in global trends, but also is extremely important information for international investors, which confirms its commitment to the principles of openness and transparency.

The future work will be directed to experimental study of some DESI indicators and factors, that influence on these. It can be studied for both EU states and Ukraine as well as strategy for Ukraine can be created and implemented.

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