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BENCHMARKING E-GOVERNMENT: CURRENT TRENDS AND DIGITAL BARRIERS TO DEVELOPMENT

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ABSTRACT

The basic principles and methodological foundations for measuring the readiness and ability of the national institutions to provide citizens and businesses with access to public services online are considered. On the occasion of the 20th anniversary of the study of the implementation of e-government tools in UN member states (UN E-Government Survey), current trends and transformations of the e-government model, the digital divide and digital barriers to further progress in the development of the digital economy and e-democracy are analyzed. The methodological basis of the study applied are techniques and methods of complex comparative analysis and logical generalization and the information base is formed by the results of the UN E-Government Survey and World Bank Governance Surveys.

1. Introduction. The rapid progress of information and communication technologies (ICT) is embodied in all spheres of life of modern society. An irreversible trend in the world development is the innovative improvement of public administration, in particular, the introduction of the e-government model and its digital transformation to solve the multifaceted and complex problems that humanity faces on a daily basis.

The e-government information and communication system is not a supplement or analogue of traditional government, its main purpose is to create conditions for the optimal functioning of all branches and levels of government, to ensure quality standards for the provision of administrative and social services to citizens and businesses based on the active use of the ICT [1]. Traditionally, there are three e-government information sectors:

- G2G (Government-to-Government) involves sharing data and provides for online interaction of government bodies of various levels (central, regional, local) and various branches of government (executive, legislative, judicial). The creation of interdepartmental networks, corporate and state databases and registers, the introduction of electronic document flow between various government structures - all this optimizes the processes of collecting and processing information, contributing to an increase in the efficiency of the state apparatus.

- G2C (Government-to-Citizens) simplifies interaction between the state and society: on the one hand, the provision of administrative and social services to citizens (electronic personal

identification, employment, declaration, social security services, etc.), on the other, public involvement in the government decision-making process.

- G2B (Government-to-Business) contains business-specific transactions (business registration, issuance of licenses and permits, declaration, interaction with fiscal authorities, government procurement, etc.), as well as the provision of business-oriented services.

There is no single generally accepted model of e-government in the world, each country decides on the level and scope of its initiatives in the field of implementation of e-government in accordance with its own national priorities. The main goal of e-government is to improve the efficiency of the executive functions of the state, to make the government more transparent and accountable to citizens and businesses, to guarantee data confidentiality and cybersecurity.

2. International e-Government research experience. E-government as a modernized form of organization of public administration was launched in 2000 as the following powerful government web portals: eCitizen portal in Singapore, FirstGov in the US, and e-citizen, e-business, e-government in the UK. Since the introduction of e-government technologies, several systems of informatization of administrative processes have changed. The rapid spread of the Internet, the massive use of innovative communication tools and various information technologies, the powerful development of social networks made it necessary to introduce deeper digital transformations into the management sphere. Each new generation of the ICTs resulted in an increase in the complexity of e-government, an expansion of the range of public services offered, and an increase in their accessibility and inclusiveness. New electronic communication platforms have become an effective tool for involving citizens and businesses in the process of making government decisions, which is declared in the Global Goals as one of the elements of sustainable development (Goal 16.7 SDG) [2].

The Department of Economic and Social Affairs (UN DESA) has been tracking progress in the development of e-government in the UN member states since 2001. Every two years, a global report is published, which analyzes at the national level: public online service systems, the state of the telecommunications infrastructure and the availability of human resources capable of promoting and using the powerful capabilities of modern ICTs. The E-Government Development Index (EGDI) is used as a generalized assessment of the level of implementation by countries of digital technologies in order to improve the interaction of public authorities and society, according to which the corresponding ratings are compiled.

The evolution of the search for and adaptation of the best e-government practices is reproduced by the topic of the UN E-Government Surveys [3]. The most iconic ones among them are: Benchmarking E-government: A Global Perspective (2001); From E-Government to E-Inclusion (2005); From E-Government to Connected Governance (2008); E-Government for the Future We Want (2014); E-Government in Support of Sustainable Development (2016); Gearing E-Government to support transformation towards sustainable and resilient societies (2018); Digital Government in the Decade of Action for Sustainable Development (With addendum on COVID-19 Response) (2020). The latest UN E-Government Survey summarizes the results of the 20-year period of transformation of public administration in the direction of its digitalization. The global COVID-19 pandemic has reinvigorated the role of e-government in both traditional digital service delivery and new innovative crisis management efforts, becoming an essential element of communication (networking, e-health, online learning, and telecommuting) [4].

The introduction of modern digital technologies (artificial intelligence, cloud technologies, as well as blockchain technologies, data analysis and the Internet of things) into the sphere of public administration contributed to the formation of an effective e-governance system and accelerated the pace of digital transformation. Technological, organizational, and strategic aspects of digitization of public administration in countries worldwide, innovative programs and best practices of e-government are actively debated in such international scientific journals as Electronic Government, an International Journal (EGIJ); International Journal of Electronic Government Research (IJEGR); International Journal of Public Administration in the Digital Age (IJPADA); Transforming Government: People, Process, and Policy (TGPPP) etc.

Topics in the journals also cover e-readiness and e-business models, introduction and dissemination of local e-government, e-democracy and e-voting, digital divide/social isolation, personal data protection, information- and cybersecurity. One cannot ignore the fundamental review [5], in which the authors analyzed more than 130 publications devoted to research on costs, opportunities, priorities and risks affecting the implementation of electronic government.

The purpose of the article is to summarize the international experience in assessing the development of e-government, to carry out a comparative analysis of the readiness and ability of governments to provide services online, to identify global trends, patterns, and contradictions in the evolution of public administration under modern conditions of digital transformations.

3. Research Methods. The E-Government Development Index (EGDI) is a key benchmarking tool for the progress achieved in the digitalization of public administration. The index aggregates 12 basic indicators, which, from the point of view of international experts, embody the country's ability to participate in the digitalization of public services and are aimed at improving the efficiency of management and the quality of life of people [6]. The basic indicators are grouped into three sub-indices: Telecommunications Infrastructure Index (TII) based on data from the International Telecommunication Union (ITU), Human Capital Index (HCI) based on UNESCO information, and Online Services Index (OSI), which is based on expert estimates from an independent survey of official government portals and websites and is being carried out by UN DESA at the stage of preparing the next ranking. Aggregation of indicators of different dimensions and different measurement scales presupposes their preliminary standardization. Within each of the above-mentioned sub-indices, the basic indicators are standardized according to the z-score procedure:

$$z_{ij} = \frac{x_{ij} - \mu_i}{\sigma_i},$$

where z_{ij} and x_{ij} are standardized and the real values of the i-th indicator in the j-th country;

μ_i and σ_i are the means and standard deviations of the i-th indicator for the sample of countries.

Algebraically, EGDI is calculated as the arithmetic mean of the named sub-indices:

$$EGDI = 1/3 \ (TII \ + HCI \ + OSI)$$

The TII sub-index assesses the state of the telecommunications infrastructure development and is determined as average of z-scores of the following four indicators (per 100 inhabitants): Internet users, mobile subscribers, fixed broadband subscribers, and active mobile broadband subscribers. In 2020, an upper limit of 120% was introduced for all indicators.

The HCI sub-index indicates how high the level of education of citizens is and whether they are ready to promote and effectively use the latest ICTs. Algebraically, the HCI is determined as the sum of the z-scores of four indicators: adult literacy (%), gross school enrollment ratio (upper bound of 100%), average duration of school completion for adults and expected duration of schooling (years).

The OSI sub-index measures the completeness of the provision of services through the web interface, the availability of online services and content, their adaptation for mobile applications, and the like. There are four stages of development of online services: emerging information services, enhanced information services; transactional services; connected services (in %). The total number of points scored by each country is standardized according to the z-score procedure in the same way as the indicators of other sub-indices.

The standardized values of each i-th sub-index of the j-th country Z_{ij} are converted into a single rating scale from 0 to 1 using the minimax criterion [4, Annexes]. Since all basic indicators are stimulants, the conversion is carried out according to the formula:

$$G_{ij} = \left(\frac{Z_{ij} - Z_{i,min}}{Z_{i,max} - Z_{i,min}} \right),$$

where G_{ij} is the rating of the i-th sub-index of the j-th country;

Z_{ij} is the standardized value of the i-th sub-index of the j-th country (for TII - average level; for HCI - the total value of human capital; for OSI - the total number of points);

$(Z_{i,max} - Z_{i,min})$ is the range of standardized values of the i-th sub-index in the sample of countries covered by the study.

Based on EGDI, countries are classified according to the level of e-government development: VH (very high, EGDI > 0.75); H (high, $0.50 \leq$ EGDI ≤ 0.75); M (medium, $0.25 \leq$ EGDI < 0.50); and L (low, EGDI < 0.25). In 2020, the EGDI ratings were supplemented with grade classes - now each group is divided into four equal intervals (quartiles), which provides a more detailed cluster analysis.

The opportunities for interaction and partnership between citizens and government are expanding with the improvement of the e-government model. To compare the willingness of countries to involve civil society and the business sector in decision-making processes, the Electronic Participation Index (EPI) is defined, which is based on the indicators of the OSI sub-index and is

practically an appendix to the EGDI with an identical division into groups. Both indices demonstrate the effectiveness of the national e-government not in absolute terms, but in relation to each other, which gives rise to each country to identify strengths, weaknesses, opportunities, and threats in public administration, and then formulate its strategy for digital transformation of the government [7], [8].

4. Results. The analysis of the UN E-Government Survey data indicates a global trend of steady development of e-government. From year to year, the number of countries with a high level of EGDI is growing and almost all countries, regardless of their geographic location and characteristics of the economic structure, are expanding the scope of using the latest ICTs to provide public online services and deepening the dialogue between the government and society. The structural shifts in the e-government development in 2016-2020 on a planetary scale are illustrated in Fig. 1.
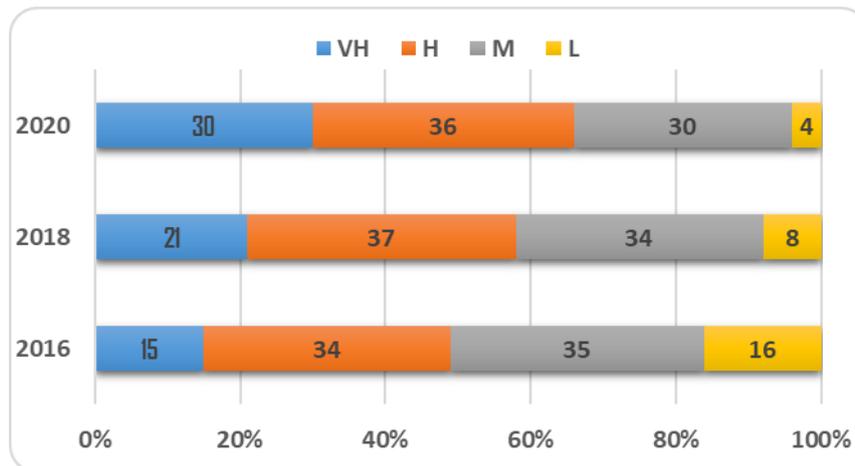

Fig. 1. The global structural shifts in the e-government development in 2016-2020.

The share of countries with the highest (VH) level of e-government development increased from 15 to 30%, but the share of countries with the lowest (L) level decreased from 16 to 4%. According to the E-Government Survey 2020, more than 2/3 of the countries received an EGDI score > 0.50, including 59 countries in the range [0.75 ÷ 1.0] (of which 14 countries were in the highest VH group); and only 8 countries remained in the L group with an EGDI score < 0.25. The average EGDI level increased from 0.49 in 2016 to 0.60 in 2020. The main drivers of e-government development over this period were: increased investment in ICT infrastructure and transformation of public services into convenient online services.

Figure 2 shows the relationship between the level of a country's economic development (by Gross National Income (GNI) per capita) and the e-government development: in countries with higher incomes, the EGDI value is significantly higher than in countries with lower incomes. At the same time, the dynamics of progress in the e-government development is demonstrated by countries in all income groups.
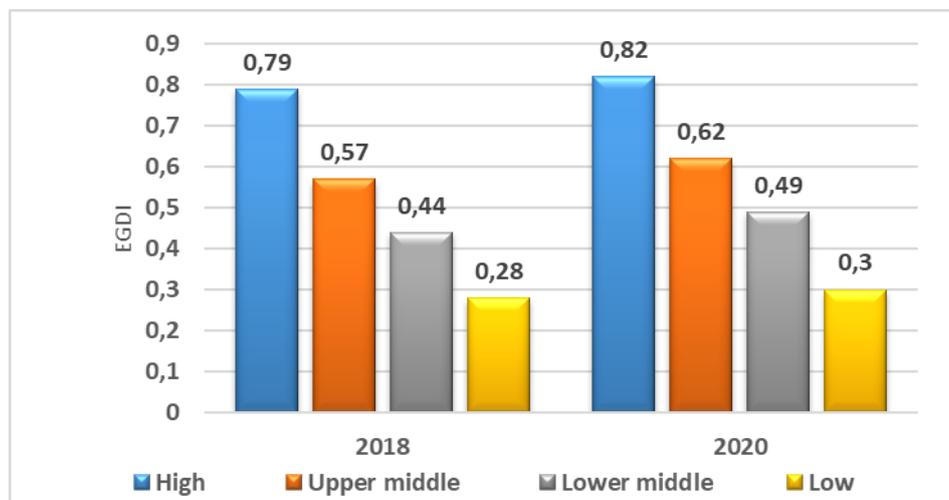

Fig. 2. Change in EGDI in groups of countries with different incomes.

All regions of the world are making progress in the development of e-government, which confirms the growth of regional values of EGDI in 2020 compared to 2018 (Table 1). The growth of EGDI values across regions is almost the same, therefore, despite certain successes in the development of e-government, regional imbalances and digital inequality persist. The oscillation coefficients, calculated for each region as the ratio of the range of variation to the mean, range from 0.41 in Europe to 1.51 in Africa. Therefore, Europe with a high EGDI value and a low level of its variation is the leader in the development of e-government. At the regional level, all 43 European countries are in the high or very high EGDI group, and eight of them are in the VH group.

Table 1. EGDI regional levels and oscillation coefficients in 2018 and 2020

Region	EGDI level		Oscillation coefficient	
	2018	2020	2018	2020
Africa	0.34	0.39	1.77	1.51
Americas	0.59	0.63	0.97	1.04
Asia	0.58	0.64	1.18	1.01
Europe	0.77	0.82	0.82	0.41
Oceania	0.46	0.51	1.82	1.29
World	**0.55**	**0.60**	**1.56**	**1.48**

One of the key aspects of public administration influencing the development of society is the involvement of citizens in the processes of formation and decision-making through information and communication channels of interaction: e-government portals and other state websites related to the provision of information to citizens, social networks, mobile platforms and devices. The most common forms of communication between government and society are e-consultations and discussion forums, moderation of thematic subgroups, submission of petitions and appeals, e-voting. Electronic innovations in the world, of course, affect the transformation of forms of communicative interaction and contribute to their fairly rapid spread from developed regions to less developed ones. However, due to legal traditions, economic and cultural differences, the level of development of e-government and forms of e-participation vary greatly by country [4], [8].

To measure the activity of communications between the government and society, the E-Participation Index (EPI) is used, which, by analogy with the EGDI, takes values from 0 to 1. According to the UN E-Government Survey 2020, a third of countries have reached the highest level (EPI>0.75); at the same time, one of five countries, due to a lack of resources for the development and implementation of ICTs, had extremely limited opportunities for e-participation and mobile management (EPI<0.25). On average, countries provided 14 of the 20 online services, which accessibility was assessed in the survey. Almost 90% of the countries ensured the development and operation of a single state portal, taking into account the principle of a "one-stop-shop". The number of countries that provide sectoral information has increased, especially the websites of government departments responsible for education, health, labor relations, social protection of the population, environmental protection, and justice. More than 3/4 of public online services are adapted for mobile devices [4].

At the same time, it should be noted that the E-Government Survey surveys essentially record information on the "supply" of e-participation, and the "demand" for e-participation remains outside these surveys. Meanwhile, numerous opinion polls in various countries, in particular the Gallup International poll, show a low level of trust in government agencies, which reduces the effectiveness of communicative interaction between government and society [8], [9].

According to the E-Government Survey 2020, 14 countries were recognized as leading in the development of e-government and e-participation (VH group), 8 of them are European. The leading countries have begun the full-scale introduction of new generation electronic government technologies - digital government, are implementing projects for the digital transformation of public administration systems, and expanding the range of online services. Unlike e-governance, digital governance provides for an integrated approach that prioritizes improving the efficiency and effectiveness of governance and its focus on achieving the Global Sustainable Development Goals [10].

To identify the advantages or vulnerabilities of digital government versus e-government, a comparative analysis is carried out using the Worldwide Governance Indicators (WGI), namely: Government Effectiveness (GE) and Control of Corruption (CC). The GE indicator is considered as a comprehensive assessment of the quality of public services, the competence of civil servants, the level of

independence of the civil service from political pressure and the level of trust in government policies; the CC indicator reflects progress in anti-corruption [11]. The measure of both WGI indicators is Percentile Ranks, which take values from 0 to 100 (higher values correspond to better results) [12].

The object of the study is 17 European countries combined in two clusters: the first cluster is represented by 8 leading countries in the development of e-government (Denmark, Estonia, Finland, Sweden, UK, Netherlands, Spain, Norway), the second - 9 countries of Eastern Europe, of which six countries are members of the European Union (Bulgaria, Hungary, Romania, Slovakia, Czech Republic, Poland) and three countries are members of the Eastern Partnership (Belarus, Moldova, Ukraine). The information base was formed according to the results of the E-Government Survey 2020 and the World Bank Governance Surveys.

The correlation coefficients in table 2 indicate the presence of a significant relationship between the level of e-government development, Government Effectiveness (GE) and Control of Corruption (CC) in all countries (the supra-diagonal coefficients of correlation measure the strength of the relationship in the cluster of leading countries, below diagonal ones - in the cluster of Eastern European countries).

Table 2. The relationship of e-government development between government effectiveness and control of corruption

Indicators	EGDI	GE	CC
EGDI	1	0.535	0.668
GE	0.672	1	0.923
CC	0.879	0.827	1

The advantages of digital government over e-government in terms of management efficiency, government transparency and control over corruption are also evidenced by the inter-cluster deviations of the average values of all three indicators. The significance of these deviations is confirmed with a high degree of probability by the *t-test* (Table 3).

Table 3. Deviations of average values of indicators EGDI, GE and CC by clusters

Cluster	# of countries	EGDI	GE	CC
I	8	0.93	93.09	93.33
II	9	0.78	58.17	52.67
Deviation	x	0.15	34.92	40.66
t-test	x	7.41	5.37	6.50

Thus, digital transformation contributes to the efficiency of public administration, government transparency, reduce corruption, the involvement of civil society and the business sector in the decision-making processes. Digital transformation brings e-government to a new, higher level, creates a qualitatively new dialogue between the state and society and is gaining more and more popularity in the world [13], [14]. However, in a large part of the countries, the implementation of a digital governance system faces a number of objective and systemic digital barriers. These are the lack of modern means of communication due to limited resources, poverty and insufficient digital literacy of the population, disability, a low level of trust in government institutions and many other obstacles. All of them are combined into one global problem of digital (information) inequality - the Digital divide.

The digital divide is a complex and multidimensional issue that reflects and simultaneously exacerbates existing social, cultural and economic inequalities. Along with the growing role played by modern technologies in public life, the social inequality is deepening between individual strata and groups of people who, for one reason or another, are limited in access to modern technologies, knowledge, information, and those who do not have such restrictions [15]. The intellectual gap between information and technologically advanced and undeveloped countries and entire regions is widening. For digitalization to work for the benefit of people, it is necessary to create equal digital opportunity, ubiquitous digital literacy and robust digital security. According to the UN Secretary General, without reducing digital inequality, the world will not be able to achieve the Sustainable Development Goals [16].

A new round of technological advances in the digitalization of management, along with the emerging progressive opportunities, creates new challenges and threats of a technological nature: unauthorized access to information that is protected by the state (state, commercial, banking secrets, personal data), cyber aggression and cybercrime. Digital transformation requires governments to adopt common privacy and data protection standards and laws, and implement effective cybersecurity mechanisms. However, no country is able to guarantee the protection of the vital interests of the state,

society and the individual, relying solely on its own forces. Cyber threats are cross-border by their nature, therefore, it is possible to prevent and counteract all kinds of attacks in cyberspace and information and communication systems only through coordinated international cooperation in the field of cybersecurity.

5. Conclusions. The transformation of the public administration system in the direction of digitalization has become a global trend. The basic component of public administration - e-government - plays a key role in establishing information communications between various branches of government, citizens, and business, in ensuring quality standards for the provision of administrative services. In the context of the 20th anniversary of the UN E-Government Survey, the stages of formation and development of e-government are revealed, global trends of its modernization are identified, and the strengths and weaknesses of national initiatives to provide administrative services and involve civil society and business structures in government decision-making processes are outlined. Emphasis is placed on intensifying the role of the e-government during the COVID-19 pandemic.

The implementation of digital transformation projects of the government in economically developed countries contributes to an increase in the efficiency of public administration, transparency of government, and a decrease in corruption. In the context of achieving the Sustainable Development Goals, the concept of digital governance puts people, their rights and freedom in the first place, embodying the principle of "state for people". At the same time, many countries around the world face fundamental challenges related to ICT development, security, digital infrastructure, and digital inequality. Addressing these issues requires concerted efforts and international partnership.

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