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DIGITAL DEVELOPMENT AND TECHNOLOGICAL INNOVATIONS: INEQUALITY AND ASYMMETRY

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Abstract: *The rapid spread of digitalization affects the development of countries and humanity, the fate of a particular person. The modern digital divide, which is researched in the article, strengthens the social stratification of the world economy and makes it difficult to achieve the Sustainable Development Goals 2030. Inequality (social and technological) limits access to technologies, the possibilities of their use, and obtaining utility for the average person, it inhibits socio-economic development and deepens the digital divide for humanity. On the other hand, the latest digital technologies create fundamentally new opportunities for progressive development. Addressing the root causes of the digital divide expands the benefits of digital technologies, which requires the implementation of digital measures in the relevant policies of sustainable recovery, coordinated joint actions of all actors in the digital ecosystem, involvement in international partnerships, application of international aid, etc. Accordingly, in modern conditions of the generation, distribution and influence of the digital technologies a difficult dilemma arises – on the one hand, to minimize the threats of digital inequality, and on the other hand, to prevent the limitation and inhibition of innovative development in order to maximize the use of the advantages of digital technologies. The article provides a comprehensive assessment of the digital development asymmetry in the regions of the world using integral indicators since the level of inequality differs significantly when compared according to various single indicators of digital development. The main aims of the study are the systematization of digital development indicators, their analysis in terms of patterns of change, irregularity and differentiation, the calculation of integral indices of digital development of regions and their ranking, and the calculation of general assessments of irregularity and divide. According to the integrated level of digital development, the European region remains the leader among other regions of the world with the highest level of digital development (82%), the Asia-Pacific region is ahead of the American region with 74.56% and 67.67%, respectively. The average world index of digital development is 64.21%. The digital divide remains very high (370.3 times) since the countries in the African region are still behind in access and use of digital technologies.*
Keywords: digitalization; digital technologies; digital divide; digital diplomacy; inequality; innovative development; international; regions of the world.

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1. Introduction. The topicality of the inequality problem in the global world is increasing every year. Global asymmetries of world economic development not only deepen the technological gap between countries but also affect their potential capacity for digital adaptations in the conditions of rapid transformations inherent in techno-globalization. Innovative development contributed to passing of the society to the society of knowledge, stimulated the question of reasonable and security use of new digital technologies. Digital practices are increasingly embedded in the modern architecture of the global world. However, new digital technologies have become not only a factor in economic development moreover it contributes to the gap strengthening between economic systems. Achieving sustainable, inclusive, equitable growth and development becomes a challenge. The tremendous growth in technology, investment, and world trade has not provided benefits for all. The COVID-19 pandemic has highlighted the importance of digitalization, which not only fundamentally changes the ways of production and trade, but also affects people's daily lives and their online activities.

Inequality has become a severe challenge for the world community and makes it impossible to achieve the Sustainable Development Goals 2030. Digital technologies contribute to the deepening of inequality which is caused by economic, social, and environmental forces, thereby increasing global asymmetries. On the other hand, it is innovations and the information technologies that create new potential opportunities: from overcoming poverty to improving education, developing health care, increasing productivity, and creating jobs. Under modern conditions, digital technologies create a unique opportunity for countries to stimulate economic development and create an inclusive society. During the crisis caused by the COVID-19 pandemic, it was digital technologies that enabled communication between people, businesses, and governments.

Digitization has not only exacerbated the problem of the digital divide. We are talking about the expulsion of certain countries, social groups, and individuals from the benefits of digital technologies. The development and implementation of digital policies consistent with the 2030 Sustainable Development Goals are being updated to address the causes of the digital divide. International aid is for implementing educational innovations based on the newest digital technologies for the least developed countries will contribute to the improvement of the population's digital skills, expanding the possibilities of using digital technologies for production and trade, compatibility, and involvement in integration processes.

2. Literature Review. Modern studies of the relationship between the digital divide and digital inequality from a global perspective increasingly ask the following questions. How did the digital divide emerge? What factors are reinforcing it? Should the digital divide between countries be associated solely with the technological component? From the perspective of classical political economics, the problem of inequality is related to the return on capital, which tends to be higher than economic growth (especially wage income, on which most people rely). Today's extreme inequality is the result of such a situation, which leads to discontent and undermines democratic values. As Piketty (2014) notes, the destabilization of the modern model of global capitalism is related to social factors, but modern economic growth and the spread of knowledge have not changed the deep structures of capital and inequality. Indeed, politics and ideology are the root causes of inequality because they determine the nature of property and distribution relations.

Inequality covers a wider range from individual to macro levels, including life path, gender, race and directly affects the most important areas that are related to the formation of social capital (Robinson et al., 2015; Lechman, 2009; Ragnedda & Muschert, 2013) point to a close connection between the digital divide and social inequality, as it is a consequence of the lack of sufficient opportunities to acquire new information and communication technologies, lack of access to quality infrastructure, high costs at low incomes, insufficient (or no) level of digital skills, education, etc. Such unequal access to information and communication technologies, accordingly, acquiring different usefulness and benefits from the use of digital technologies, in its turn, reproduces social stratification. The digital divide is becoming a fundamental aspect of social inequality in the information age. The lack of relevant digital skills limits access to the use of technology, however, it is important to emphasize that lower levels of digital skills lead to lower levels of interaction with the Internet, which in its turn becomes an important feature of digital exclusion. In addition, the very value of the Internet, its role and its impact on people's lives is related to the quality of Internet bandwidth (Van Deursen et al., 2017). Internet usage shows existing social inequalities as digital networks reproduce offline structures and offline human capital is transferred to the online world. Thus, social inequality (gender, disability, race, etc.) acts as a precondition for the digital divide.

In the context of the pandemic, the pace of digitalization has increased even more, and the enhanced influence of digital assets has created real risks of a significant growth in dependence on digital technologies. A study of the impact of COVID-19 conducted by Jun et al. (2022), revealed not only various rates of economic recovery from the pandemic in different countries of the world. What has become important is that

the uneven economic recovery in different countries has caused an even greater exacerbation of socio-economic inequality around the world – a rapid regeneration for some groups and a constant lag for others (the inequality virus). The digital divide increased the butterfly effect, and the pandemic, according to Jun, et al. (2022) further exacerbated digital and social inequalities, and led to augmentation of the further marginalization of society (Oldekop et al., 2020). The technological component of the formation of the digital divide is characterized by access to technologies, and a gap in their use (information chain of value creation, digital skills, level of knowledge, structure of demand, etc.). The integration of digital innovations into production processes is becoming an actual manifestation of geo-economic rivalry (Panchenko et al., 2021), this, in its turn, affects competitive relations in digitalized markets in the context of intensifying manifestations of techno-globalization, since the use of policy tools of information-digital and innovative neo-protectionism leads to distortion of markets (Reznikova et al., 2023b).

The digital divide is not only related to purely technological access because, on a global scale, the gap refers to the social and economic development of countries and regions. On the other hand, Ho & Tseng (2006) emphasize that it is the level of socio-economic development that is important for the spread of information technologies. Van Dijk (2020) singles out six main factors of the digital divide: the access gap (direct technological availability, as well as the availability of the Internet in terms of its cost, quality, etc.); literacy gap (digital skills, digital education); usage gap (applies directly to Internet activities – e-commerce, e-education, digital media, degree of coverage, etc.); capacity gap (additional training opportunities, advanced skills); participation gap (e-government, security, online employment); gap in results (profits, social networks, public goods, etc.). Heeks (2022) underlines that because of the existing digital divide due to the chronic poverty of the least developed countries, unfavorable digital incorporation arises, which allows more developed and socially protected groups involved in the digital system to receive disproportionate value from access to and use of resources through the exclusion of certain social groups from existing digital systems, lack of access to their advantages. Such differentiation results from established relations of ownership and control, under which some group receives the corresponding privileges, including inequally assigning the received value. Heeks (2022) relates this to the fact that this privileged group has appropriate control over system design (directly designs processes, runs digital systems, etc).

Another privileged group has limited access to digital systems, and due to resource inequality (less access to human, social, financial capital) because of which differential use of advantages arises. Such inequality can also be aggravated by imperfect norms and rules (institutional inequality), resulting in similarly limited access to the benefits of the system for certain groups of users. And finally, there may be inequality of relations, in which the asymmetry of dependence is determined by the nature of dependency between actors in the digital system. Responsible and inclusive digital transformation requires active support from all levels of government, namely the policies they provide. Yeraliyeva et al. (2023) make ad hoc accent on the coherence of policy, regulatory and legal framework, public-private partnership, cooperation of all parties interested in increasing the efficiency of state management of the digital economy. Successful digitalization practices are substantiated by Shkolnyk et al. (2022) with the example of the financial sector and prove that the digitization of management even in wartime will contribute to the stable functioning of the economic system.

3. Methodology and research methods. The article aims to prove the relationship between the technological and social components of the digital divide and determine the extent and dynamic changes in the asymmetry of digital development of the world's regions under modern conditions. To assess the degree of asymmetry of digital development and the digital divide in countries, the paper uses the following methodological approach, which consists of the following steps:

First, the systematization of quantitative indicators for the assessment of digital development with the justification of the nature of the impact on the level of integration of countries and regions

Second, the assessment of the regularity of change of the specified indicators and the statistical analysis of the unevenness and differentiation of the development of countries/regions. The analysis was carried out based on the following indicators:

- The intensity of change (CR), which characterizes by what percentage the indicator increased or decreased in the analyzed period.

$$Change\ rate\ (CR) = \frac{x_i - x_0}{x_0} \times 100 \quad (1)$$

- Quadratic coefficient of variation, which evaluates the totality of regions for homogeneity according to indicators of digital development and allows to compare it.

$$Variation\ rate\ (VR) = \frac{\sigma}{\bar{x}} \times 100 = \frac{\sqrt{\sum(x-\bar{x})^2 / n}}{\bar{x}} \times 100 \quad (2)$$

- The level of differentiation of regions, which is calculated by the ratio of the maximum and minimum values of the digital nodal indicators for the totality of regions.

$$Differentiation\ rate\ (DR) = \frac{x\ max}{x\ min} \quad (3)$$

Third, the formation of an integral assessment of the level of digital development, which involves the aggregation of certain indicators based on their prior standardization (norming).

The *min-max* method was used in the study to standardize the input data and bring them to a comparative form based on the application of the following formulas:

$$P_{ij} = \frac{x_{ij} - x_{min}}{xmin_{max}} \quad (4)$$

For stimulator indicators, in the event that an increase in the value of the indicator under consideration should lead to an increase in the integral indicator itself:

$$P_{ij} = \frac{xij_{max}}{xmin_{max}} \quad (5)$$

For destimulator indicators, on the contrary, when the value of the indicator increases, the final integrated assessment should decrease.

For aggregating standardized indicators, a linear method was used, which involves the calculation of an integral indicator (index) in the form of an arithmetic average:

$$I_{j(\%)} = \frac{\sum_1^m P_{ij}}{m} \times 100 \quad (6)$$

where j – the number of regions; i – the number of indicators; P_{ij} – the standardized values of the indicators.

Fourth, the assessment of the integral level of digital development and the gap based on the obtained integral assessments. The information source for the relevant calculations is the statistical base of the International Telecommunication Union (ITU) and UNCTADStat data (UNCTADStat).

4. Results. Based on the statistical database of the International Telecommunication Union and UNCTADStat, (Table 1) systematizes a group of indicators that reflect (from the point of view of the nature of their impact) the features of information technology usage, the features of access to them and the level of their accessibility, the effectiveness of the development, implementation, and use of ICT. The dynamics of the given indicators for the period 2015-2022 by world region is shown in the Tables 6-14 in the Addition.

Table 1. Systematization of digital development indicators

Indicator	Category	Nature of influence
Individuals using the Internet, % population	Connectivity, Use	Stimulator
Active mobile-broadband subscriptions, per 100 people	Connectivity, Access	Stimulator
Fixed-broadband subscriptions, per 100 people	Connectivity, Access	Stimulator
Population coverage, by mobile network technology (at least 4G)	Connectivity, Access	Stimulator
Fixed-broadband Internet basket, % GNI per capita	Affordability	Destimulator
Data-only mobile broadband basket, % GNI per capita	Affordability	Destimulator
International bandwidth usage, Mbit/s per internet users	Connectivity, Infrastructure	Stimulator
ICT goods export, %	ICT Results	Stimulator
ICT goods import, %	ICT Results	Stimulator

Sources: developed by the authors.

By the end of 2022, 5,3 billion of the world's inhabitants (66% of the total population) use the Internet (Table 2). At the same time, 2,7 billion people do not have enough access to the Internet, even though

achieving universal digital communication is the key to ensuring digital transformation.

Table 2. Individuals using the Internet, % population

Regions	2015	2016	2017	2018	2019	2020	2021	2022	Change rate 2022/2015, %
Africa	16	19	21	24	28	32	35	40	150,0
Arab States	38	41	47	50	55	62	66	70	84,2
Asia & Pacific	34	37	39	43	49	57	60	64	88,2
CIS	62	66	68	73	76	79	81	84	35,5
Europe	73	75	77	80	82	84	87	90	23,3
The Americas	62	68	72	74	76	80	81	83	33,9
World	40	43	46	49	54	60	63	66	65,0

Sources: developed by the authors.

The Internet usage indicator is one of the readings of digital development, the level of which should globally reach 100% (Zavazava, 2022) (Table 3).

Table 3. Achieving universal and meaningful digital connectivity

Indicator	Criterion
	Universality targets
100%	of population aged 15+ uses the Internet
100%	of households have Internet access
100%	of businesses use the Internet
100%	of schools are connected to the Internet
100%	of population is covered by a mobile network of the latest technology
100%	of population aged 15+ owns a mobile phone
>70%	of population aged 15+ has basic digital skills
>50%	of population aged 15+ has intermediate digital skills
Gender parity	is achieved for Internet use, mobile phone ownership and use, and digital skills
	Technology targets
100%	of fixed-broadband subscriptions are 10 Mb/s or faster
20Mb/s	Minimum download speed at every school
50kb/s	Minimum download speed available per student
200GB	Minimum data allowance for every school
	Affordability targets
2%	Entry-level broadband subscription costs less than 2% of gross national income per capita
2%	Entry-level broadband subscription costs less than 2% of average income of the bottom 40% of population

Sources: developed by the authors.

For highly developed countries, the level of Internet users is already 92.4%, i.e., it is almost close to the specified indicator. Regionally, the highest level of Internet users is in European countries (89%), the lowest is in the African continent (40%). For the analysed period of 2015-2022, the most intensive growth rates of the portion of users were observed in the regions with the smallest number of users, namely in African countries (150%), Arab countries (84,2%), and countries of the Asia-Pacific region (88,2 %). Thus, the Internet usage gap remains a problem.

The percentage of people who own a mobile phone is currently higher (72,7%) than the percentage of Internet users (66,3%), but this gap is narrowing every year (it was 69,3% vs. 59,6% in 2020). Europe and the Americas are the leaders in mobile broadband subscriptions (110 subscriptions per 100 people in 2022), while Africa has 42 subscriptions per 100 people (Table 4).

Growth was observed in all regions in 2015-2022, with the most intensive rates demonstrated by the countries of the Asia-Pacific region (134,2%) and the countries of the African region (121,1%). The indicator of the number of subscriptions to fixed broadband services is the highest in the countries of Europe (35 subscriptions per 100 people), the countries of the American region (25 subscriptions per 100 people), the CIS

countries (21 subscriptions per 100 people), it is the lowest for the countries of Africa region (0,7 subscriptions per 100 people) (Table 5).

Table 4. Active mobile-broadband subscriptions, per 100 people

Regions	2015	2016	2017	2018	2019	2020	2021	2022	Change rate 2022/2015, %
Africa	19	22	26	30	34	38	39	42	121,1
Arab States	42	46	54	59	60	63	69	74	76,2
Asia & Pacific	38	46	62	70	75	79	84	89	134,2
CIS	61	65	73	78	86	92	97	100	63,9
Europe	69	78	86	92	98	100	100	110	59,4
The Americas	79	86	90	95	98	100	110	110	39,2
World	45	52	63	70	74	78	82	87	93,3

Sources: developed by the authors.

Table 5. Fixed-broadband subscriptions, per 100 people

Regions	2015	2016	2017	2018	2019	2020	2021	2022	Change rate 2022/2015, %
Africa	0,4	0,4	0,4	0,4	0,5	0,6	0,6	0,7	75,0
Arab States	4,7	5,1	6,9	7,4	7,5	8,7	9,7	10,0	112,8
Asia & Pacific	9,8	11,0	13,0	13,0	14,0	15,0	17,0	18,0	83,7
CIS	15,0	16,0	18,0	19,0	18,0	20,0	21,0	21,0	40,0
Europe	28,0	29,0	30,0	32,0	32,0	34,0	34,0	35,0	25,0
The Americas	19,0	19,0	20,0	21,0	21,0	23,0	24,0	25,0	31,6
World	11,0	12,0	14,0	14,0	15,0	16,0	17,0	18,0	63,6

Sources: developed by the authors.

During the analysed period, the level of subscriptions increased most intensively in the countries of the Arab world (112,8%) and the countries of the Asia-Pacific region (83,7%), however in comparison with subscriptions to mobile communication, the intensity of growth in the level of subscriptions to fixed communication is smaller.

The number or intensity of subscriptions to mobile or fixed communication services are indicators of access to information resources and their usage; their growth indicates the intensification of digitalization processes of social development. Wherein, the level of subscriptions for fixed broadband is lower than that of mobile one because the former is used jointly within households, while the latter is used by individuals. The degree of mobile communication coverage of different levels (2G-5G) is the main prerequisite for Internet access, accordingly, the increasing spread of modern 4G and 5G technologies is evidence of digital development. Having admission to a mobile phone is a significant means to access the Internet (often the only one). Mobile technologies continue to develop rapidly both quantitatively (expansion of mobile network 3G and above) and qualitatively (4G replaced by 5G technology). Global coverage of the 3G network is 94,8%, including 99,7% in highly developed countries. During 2015-2022, the coverage of the 4G network has doubled and is already 88% in general – 99% of Europe, 97% of the Asia-Pacific region, and 92% of the population of America and the CIS countries (Table 6).

Table 6. Population coverage, by mobile network technology (at least 4G)

Regions	2015	2016	2017	2018	2019	2020	2021	2022	Change rate 2022/2015, %
Africa	10	16	22	38	34	40	47	50	400,0
Arab States	19	27	50	61	62	74	75	76	300,0
Asia & Pacific	42	73	87	91	93	95	95	97	131,0
CIS	43	52	61	67	80	84	87	92	114,0
Europe	74	87	90	98	98	98	99	99	33,8
The Americas	73	78	82	86	90	91	91	92	26,0
World	43	64	75	80	83	85	87	88	104,7

Sources: developed by the authors.

For African countries, this figure is 50%, but since 2015 it has increased 5 times. By the beginning of 2022, 19% of the world's population was covered by the 5G network (including by region: European 52%, American – 38%, Asia-Pacific – 16%), (ITU, 2023). According to forecast estimates, by the end of 2025, 5G will be about a quarter of the total number of mobile connections, and the availability of the 5G network will be 40% of the population (GSMA, 2022). For low-income countries, the basis of mobile networks is 2G and 3G, which remain crucial means of communication. In turn, most European and Asia-Pacific operators plan to turn off their 3G networks by the end of 2025. It should be noted, that even for highly developed countries, inequality within the country is a significant barrier to access to digital technologies. Thus, in the American region, 22% of the rural population is not covered by mobile signals at all, and 5% have access only to the 2G network, which means that 27% of this population does not have access to the Internet (GSMA, 2022).

Indicators of the availability of digital services are related to the level of prices for their connection with the mobile broadband access basket for data transmission only and the fixed broadband access basket acting as a benchmark; the decrease in their costs indicates an increase in the availability of services and broader access to the Internet. In the countries of Europe and the CIS, the cost of access to fixed communication services is 1,3% of the gross national income per capita, mobile communication for data transmission is 0,51 and 1,1% of the GNI per capita, in the countries of Africa, these costs are 18% and 5,1%, respectively. The world is characterized by a trend of cheaper access to mobile communications for data transmission (by 7,1% for period 2015-2022) and, conversely, an increase in the cost of access to fixed broadband services (by 30,4%) (Table 7-8).

Table 7. Fixed-broadband Internet basket, % GNI per capita

Regions	2015	2016	2017	2018	2019	2020	2021	Change rate 2021/2015, %
Africa	24	20	21	20	20	18	18	-25,0
Arab States	2	2,3	1,9	3,1	3,1	3	3,3	65,0
Asia & Pacific	4	3,9	3	2,8	3	3	3,1	-22,5
CIS	1,4	0,94	1,4	1,4	1,4	1,2	1,3	-7,1
Europe	0,98	1,1	1,2	1,3	1,4	1,3	1,3	32,7
The Americas	4,1	3,7	4,5	4,3	4,7	4,7	5,1	24,4
World	2,3	2,6	2,5	2,8	2,8	2,8	3	30,4

Sources: developed by the authors

Table 8. Data-only mobile broadband basket, % GNI per capita

Regions	2015	2016	2017	2018	2019	2020	2021	Change rate 2021/2015, %
Africa	12	9,1	8	5,1	5,1	4,4	5,1	-57,5
Arab States	1,3	1,1	1,3	1	1,3	1	1,2	-7,7
Asia & Pacific	1,9	2,1	1,8	1,4	1,1	1,3	1,2	-36,8
CIS	1,1	0,68	0,93	1,4	1,4	0,96	1,1	0,0
Europe	0,59	0,6	0,64	0,72	0,81	0,56	0,51	-13,6
The Americas	2,6	2,3	2,7	2,4	2,4	2,3	2,4	-7,7
World	1,4	1,5	1,4	1,4	1,4	1,2	1,3	-7,1

Sources: developed by the authors.

By region, there is a general trend towards a decrease in the availability of the basket of mobile communication services for data transmission compared to the basket of fixed communication services; it became more accessible in the countries of Africa (decrease by 25%), Asia and Oceania (by 22,5 %) and CIS countries (by 7,1%). The United Nations Broadband Commission for Sustainable Development has defined a benchmark for these indicators – establishing by 2025 the availability level of broadband access at a cost of less than 2% of the gross national income per capita (Table 1).

The indicator of the use of international bandwidth is an index of the demand for international data and the availability level; the growth is due to the activation of the processes of global consumption of Internet data. International bandwidth usage in the world in 2022 was 230 Mb/s per user, with the greatest demand for global data in Europe and the Americas. Compared to other indicators of digital development, the dynamics of the level of international bandwidth usage is characterized by the highest growth rates, namely 342,3% in the

world during the analysed period, 672,7% in African countries, 413,5% in the cranes of Asia and Oceania (Table 9).

Table 9. International bandwidth usage, Mbit/s per internet users

Regions	2015	2016	2017	2018	2019	2020	2021	2022	Change rate 2022/2015, %
Africa	11	11	25	28	35	60	72	85	672,7
Arab States	39	47	66	84	98	120	140	170	335,9
Asia & Pacific	37	52	77	98	120	130	170	190	413,5
CIS	34	54	65	65	68	87	100	120	252,9
Europe	99	110	120	160	210	260	330	400	304,0
The Americas	64	70	73	96	130	170	210	260	306,3
World	52	67	85	110	130	150	200	230	342,3

Sources: developed by the authors.

Recent indicators reflecting the development of trade in ICT services testify to the ability of countries to create and distribute ICT, on the one hand, and to be able to buy and use it on the other. Their largest share in the export and import of the countries of the Asia-Pacific region is 23,12% and 21,1%, respectively (Tables 10, 11). The highest rates of growth of the specific weight of ICT exports and imports are characteristic of the countries of the Arab world.

Table 10. ICT goods export, %

Regions	2015	2016	2017	2018	2019	2020	2021	Change rate 2021/2015, %
Africa	1,12	1,05	0,83	0,75	0,81	0,76	0,99	-11,6
Arab States	1,20	1,16	3,15	2,97	3,49	4,50	4,20	250,0
Asia & Pacific	20,57	20,91	21,5	21,64	21,83	24,32	23,12	12,4
CIS	0,69	0,53	0,54	0,42	0,47	0,47	0,54	-21,7
Europe	4,64	4,72	4,68	4,6	4,71	5,09	4,7	1,3
The Americas	7,69	7,83	7,63	7,21	7,17	7,79	6,96	-9,5
World	12,03	12,12	12,35	12,29	12,4	14	13,16	9,4

Sources: developed by the authors.

Table 11. ICT goods import, %

Regions	2015	2016	2017	2018	2019	2020	2021	Change rate 2021/2015, %
Africa	4,95	4,81	4,50	4,61	4,78	4,42	4,62	-6,7
Arab States	5,35	5,26	9,43	8,18	8,23	8,93	8,72	63,0
Asia & Pacific	18,66	19,59	19,81	19,54	19,67	22,56	21,41	14,7
CIS	7,45	7,19	7,37	8,00	7,58	8,52	8,48	13,8
Europe	7,82	7,62	7,72	7,66	7,72	8,48	7,90	1,0
The Americas	12,39	12,63	12,68	12,20	11,88	13,23	12,55	1,3
World	13,04	13,26	13,48	13,27	13,27	15,03	14,23	9,1

Sources: developed by the authors.

The achieved results of the analysis of dynamic changes in the principal indicators characterizing the state of development of digitalization in a regional section make it possible to assess the inequality and asymmetry of the digital development of the regions of the world economy (Table 12).

The slightest regional variation is observed in terms of the fraction of Internet users (27,8%), subscriptions to mobile communication (30,1%), and the level of mobile communication coverage for 4G technology (21,2%). VR is less than 33%, respectively, and the totality of regions according to these indicators in 2022 is homogeneous. The gap in indicators is 2,3, respectively; 2,6; 1,98. The highest level of variation and heterogeneity of regions was found in the indicators of the cost of fixed communication basket (212%) and mobile communication for data transmission (128,9%), the gap between regions according to the indicators is 13,8 and 10, respectively. High variation and heterogeneity regions can be ascertained by such indicators

of digital development as fixed line subscriptions (66,2%), the level of use of international bandwidth (49,2%), ICT export (63,6%), ICT import (41,2 %). At the same time, the highest level of disparity is characteristic of the fixed line subscription rate (50 times) and ICT export (42,8 times). Despite the preservation of the significant unevenness of the digital development of the regions, as evidenced by the obtained estimates, the positive trend is the reduction of the level of unevenness and gap in all indicators, except for the ICT export and the share of ICT import.

Table 12. Indicators of unevenness and asymmetry assessment of digital development by world region

Indicator		2015	2016	2017	2018	2019	2020	2021	2022	Change,%
Individuals using the Internet, % population	VR	54,0	51,1	47,7	44,8	38,5	32,8	30,6	27,8	-48,5
	DR	4,6	3,9	3,7	3,3	2,9	2,6	2,5	2,3	-50,0
Active mobile-broadband subscriptions, per 100 people	VR	49,5	45,6	37,4	34,4	33,6	31,3	31,6	30,1	-39,2
	DR	4,2	3,9	3,5	3,2	2,9	2,6	2,8	2,6	-38,1
Fixed-broadband subscriptions, per 100 people	VR	91,2	85,4	74,3	79,2	73,0	72,7	68,3	66,2	-27,4
	DR	70,0	72,5	75,0	80,0	64,0	56,7	56,7	50,0	-28,6
Population coverage, by mobile network technology (at least 4G)	VR	61,99	45,23	35,21	28,07	29,24	25,35	22,03	21,21	-65,8
	DR	7,71	5,44	4,09	2,58	2,88	2,45	2,11	1,98	-74,3
Fixed-broadband Internet basket, % GNI per capita	VR	385,9	280,7	307,6	257,1	255,8	228,7	212,0	…	-45,1
	DR	24,5	21,3	17,5	15,4	14,3	15,0	13,8	…	-43,7
Data-only mobile broadband basket, % GNI per capita	VR	310,2	216,1	197,2	115,7	114,5	118,6	128,9	…	-58,4
	DR	20,3	15,2	12,5	7,1	6,3	7,9	10,0	…	-50,7
International bandwidth usage, Mbit/s per internet users	VR	58,5	48,3	35,8	39,6	46,2	47,1	46,2	49,2	-15,9
	DR	9,0	10,0	4,8	5,7	6,0	4,3	4,6	4,7	-47,8
ICT goods export, %	VR	63,5	64,5	63,6	64,6	64,2	63,2	63,6	…	0,2
	DR	29,8	39,5	39,8	51,5	46,4	51,7	42,8	…	43,6
ICT goods import, %	VR	40,2	42,7	40,1	39,5	39,7	41,9	41,2	…	2,5
	DR	3,8	4,1	4,4	4,2	4,1	5,1	4,6	…	21,1

Sources: developed by the authors.

The unevenness level compared by different single indicators of digital development differs significantly, which determines the expediency of combining indicators within the framework of one comprehensive integral indicator with the following generalized assessment of unevenness and gap. The result of the calculation of integral indices is systematized in (Table 13).

Table 13. Integral indices of digital development of world regions

	2015		2016		2017		2018		2019		2020		2021		2022	
Regions	Ij	rank	Ij	rank	Ij	rank	Ij	rank	Ij	rank	Ij	rank	Ij	rank	Ij	rank
Africa	0,24	6	0,28	6	0,15	6	0,17	6	0,18	6	0,14	6	0,22	6	0,22	6
Arab States	37,08	5	37,57	5	47,63	5	45,99	5	45,48	5	47,83	5	46,99	5	47,54	5
Asia & Pacific	61,40	3	66,14	3	72,94	2	72,57	2	74,58	2	73,02	2	73,89	2	74,56	2
CIS	54,84	4	57,21	4	58,90	4	55,92	4	57,94	4	59,68	4	58,79	4	59,93	4
Europe	80,46	1	80,69	1	81,61	1	81,72	1	82,18	1	82,35	1	80,43	1	82,00	1
The Americas	73,90	2	72,63	2	70,96	3	68,27	3	68,89	3	68,38	3	67,60	3	67,76	3
World	58,39		61,02		65,29		63,53		64,35		64,01		63,98		64,21	

Sources: developed by the authors.

The European region has the highest level of digital development, namely 82% in accordance with the data in 2022, which is 1,9% higher than the level of 2015, and is the leader among other regions. The Asia-Pacific

region ranks second in terms of the integrated level of digital development since 2017, ahead of the Americas region. The index is 74,56% according to the data of 2022, which is 21,4% higher than in 2015. The American region ranks third with an integrated digital development score of 67,67%, which is 8,3% lower than in 2015. The CIS countries, by an integrated assessment of 59,93%, occupy the fourth place within the analyzed period, which is 9,3% higher than in 2015. The countries of the Arab world have a fifth place in the ranking with an assessment of the level of digital development of 47,54%, which by 28,2% higher than in 2015. The African region has the lowest integrated level of digital development, while the integrated assessment does not exceed 1%. The average world index of digital development is 64,21%, which is 10% higher than the level of 2015, and it is characterized by minor changes in 2018-2022.

No region has reached the maximum level of using the potential of digital development, for Europe the potential possible growth can be estimated at 18%, the Asia-Pacific region – at 25,44%, American region – at 32,24%, CIS countries – at 40%, Arab countries – 52,46%, African countries – 99,78%. Table 14 shows the result of calculating the unevenness indicators at the gap by the integral level.

Table 14. Assessment indicators of unevenness and integral level of digital development of world regions

	2015	2016	2017	2018	2019	2020	2021	2022
Variation rate	57,0	56,3	53,3	54,1	54,2	53,3	53,3	53,3
Differentiation rate	334,8	284,6	530,9	473,0	464,6	609,5	363,2	370,3

Sources: developed by the authors.

The level of variation is 53,3%, which indicates the heterogeneity of regions in terms of digital development, while in recent years (2020-2022) it is at an unchanged level, and compared to 2015, it decreased by 3,7 percentage points. The gap remains very high (370,3 times) since the countries of the African region remain significantly behind in the possibilities of access and use of information and communication technologies.

The reasons for the existing digital divide depend not only on regional affiliation. Lack of accessibility, low digital skills, exclusion or limitations for certain population groups (women, elderly, rural population, disabled, IDPs) will remain the most relevant. Addressing the causes of the digital divide will extend the benefits of digital technologies to more people, accordingly, this requires concerted joint actions for all participants/actors of the digital ecosystem. Digital inclusion involves the development of skills in the field of technology and innovation, including through the development of international cooperation (UNCTAD,2021b). Appropriate use of digital technologies, supported by appropriate infrastructure, can contribute to reducing the gap and inequality in developing countries.

Modern methods of statistical observation do not allow us to fully determine the scale of the digital economy, which is estimated from 5,2% to 28% for countries with developed economies (Knickrehm et al., 2016). In 2021 mobile technologies and services generated $4,5 trillion in value-added, or 5% of global (GSMA,2022). However, even the estimated indicators give reason to determine the immense impact of digitalization on the countries' development and humanity as a whole, since digital technologies provide not only transformation but also create opportunities. Digital services delivered through digital technologies are constantly growing and account for almost 2/3 of global services exports ($3,8 billion) (UNCTADstat, n.d.a).

From the point of view of involvement in the digital economy, two leaders have already clearly stood out today – the USA and the People's Republic of China, which together dominate in various segments of digitization (UNCTAD, 2021a): 50% of the world's data centers, the highest rates of 5G implementation in the world, 94% of the world's AI start-up funding, 70% of the world's top AI researchers, 90% of the market capitalization of the world's largest digital platforms (Apple, Microsoft, Amazon, Alphabet (Google), Facebook, Tencent and Alibaba). In fact, we are not just talking about digital platforms, but about established global digital corporations whose influence has a planetary scale.

Mega volumes of information practically provide complete quantitative indicators and qualitative preferences of the modern consumer. The source of such information (including unconsciously) is the data that people provide voluntarily in social networks, registering on sites and platforms, thereby providing relevant social, psychological, gender, professional, religious, and political characteristics and family ties which belong to the private sphere. The cheapening and availability of technological solutions have expanded the limits of their application. Wiki sites, blogs, social networks, and other platforms that allow you to share information and your thoughts with the world are becoming momentous resources for development. In the digital age, people have more and more opportunities and tools to share information. Every month, more than 3,51 billion people actively use Facebook, Instagram, WhatsApp, or Messenger. The Facebook network is

visited daily by 1,91 billion users on average; five new profiles emerge every second; on average, the Facebook user spends 20 minutes on one visit to the network, and 50% of 18-24-year-old people log on to Facebook as soon as they wake up (Zephoria, 2021).

Hence, a comprehensive and complex portrait of the consumer originates, the consideration of which, on the one hand, makes it possible to widely apply a client-oriented approach to meet his needs. However, on the other hand, precisely because of such an array of information about everyone, the world becomes more vulnerable, which confirms the annual increase in cyber-attacks. The reaction to this is the emergence of a new "informational nationalism" associated with requirements for the use of domestic technologies, storage of information about residents exclusively on the territory of the country, etc., (World Bank, 2016).

International organizations, governments of countries, government institutions, political leaders, and diplomats very actively use Facebook, Twitter, Instagram, and other networks to form an image of themselves and deliver the main news about their activities to the audience of other countries and international organizations. Public diplomacy actors close to government structures are perceived as more influential, capable of attracting resources and participating in the formation of a strategic vision through traditional diplomatic messages, while actors close to the individual level are less effective due to the need to accumulate the potential of "soft forces" however, in a strategic perspective, the power of this influence is increasing. Digital diplomacy has become a crucial component in the system of diplomatic relations (both official and public), which is reduced to the web and information technologies in the implementation of diplomatic tasks, which is not able to replace them but can perform an exclusively pragmatic function of quickly filling the information space about objective information.

The absolute accessibility of the Internet, along with its impact on socio-political processes, social relations, communication, and the economy, will also entail the final incorporation of Internet access into the international human rights system. The beginning of this trend has been observed since the 2000s. Citizens' access to the Internet is recorded as their inalienable right in the laws of Finland, Estonia, France, Greece, Spain, Costa Rica, and Switzerland. On July 5, 2012, the resolution of the UN Human Rights Council "On the Promotion, Protection, and Exercise of Human Rights on the Internet" formulated a decisive principle, according to which "the rights that a person has offline should be equally protected online, in particular, freedom of expression views, which is employed regardless of borders and to any mass media chosen by the person, following Article 19 of the Universal Declaration of Human Rights and the International Covenant on Civil and Political Rights" (The United Nations Human Rights Council's, 2012). In the future, in most international legal acts, national legislation, and even in judicial practice, the right to access the Internet is considered primarily as a condition and guarantee for the realization of human rights (Popovich et al., 2020).

Low levels of digital skills are holding back digital transformations, which are crucial for driving development. According to UN forecasts, by 2030, almost half of the jobs in the world will disappear (Frey,2012). Along with that, 90% of the new jobs that will appear shortly will require digital skills, mainly in computer, mathematics, architecture, and engineering sectors (Mlambo-Ngcuka, 2018). Communication and collaboration skills average 50% (data from 78 reporting countries, with a range of 31% to 65%). The use of digital skills in solving problems, ensuring security, creating content, information literacy, and the level of their mastery allows not only to ensure the use of the Internet but also to get the maximum benefits from it while minimizing risks (ITU, 2023). An equally significant barrier in addition to skills for the most population, who currently have limited (or no) access to digital technologies, is the cost of communication and the Internet, including the devices required to access the Internet. Fixed broadband has become less affordable for many users, and relative prices have risen from 2,9% of GNI per capita in 2020 to 3,3% in 2022, while for high-income countries this indicator is 1,1% of GNI per capita, and for low-income countries – 31,1%, respectively (Zavazava, 2022).

High levels of inequality are a hazardous obstacle to sustainable economic growth and poverty reduction in the world. Technologies improve productivity, but their concentration in a small number of companies increases the threat of monopolization. There is a high potential for new technologies to ensure sustainable development, but it is possible if equal access to these technologies is provided. Most of the population is currently involved in some digital systems, but despite this, the inequality growth is only increasing. Before the COVID-19 pandemic, almost 700 million people remained in extreme poverty, and due to the coronavirus, this number has increased by another 150 million.

Due to the pandemic, it is estimated that in 2022 global Internet traffic exceeded all traffic used before 2016, while the major part – about 80% – was made up of videos, social networks, games, etc. Digital technologies require high-quality and high-speed Internet. It should be considered that even with its presence, the imbalances of the digital economy are significant (we are talking not only about the different speeds of

the Internet, and its cost but also the gap between rural and urban areas and gender gap). Only 20% of the population (UNCTAD, 2021a) in the least developed countries use the Internet, which is characterized by relatively low speed simultaneously with a high price.

Modern digital transformation has a wide range of impacts on society, which requires adequate proactive nationwide digital political responses (Jun et al., 2022). The massive expansion of data flows affects the achievement of almost all sustainable development goals, but their influence not only stimulates trade, innovation, economic progress but also and forms problematic issues related to the distribution of profits from digitalization, human rights, security, which actualizes the search for new management mechanisms and tools (both at the national and global levels) (UNCTAD, 2021a).

Because of unequal access to technology, access to benefits faces corresponding constraints. For example, low-quality Internet prevents access to quality education provided remotely, limited access to the Internet closes access to modern telemedicine, digitization of employment deepens inequality of opportunities in society, etc. It is worth mentioning that the consequences of digitalization for representatives of different generations also have a differentiated nature. The results of digitalization, which representatives of the Gen Z generation receive, affect the reduction of opportunities for previous generations (Z-inequality), (Reznikova et al., 2023a), and this is more than the classical understanding of inequality related to the comparison of social, economic, environmental asymmetries between people, groups of people, countries. The formation of Gen Z coincides with the global spread (since the mid-1990s) of digital technologies; in fact, we are talking about the first digital generation in human history and its relation to the institution of ownership. Gen Z has its own specificity of consumption and is distinguished by alienation from the traditional value system, as there is a reorientation towards post-material values. For such a generation, virtual reality combines the real and virtual worlds.

The Internet economy promotes natural monopolies, due to the lack of a competitive environment, the concentration of economic power increases. Modern artificial intelligence systems and large data sets have made humanity more vulnerable (digital monitoring, digital amnesia, digital discrimination, generation of "unnecessary people"). A big problem is an ethical management of powerful digital tools by governments and companies. The lack of effective institutions (transparent and accountable) that ensure state investment in the development of digital technologies will contribute to the influence of elites, which, as noted by World Bank experts in the "Digital dividends" Report, may lead to increased state control and subordination of policy to the interests of elites (World Bank, 2016). Thus, digital technologies should occupy a substantial place in the relevant (Policies for resilient recovery) by:

- prioritization of the digital transformation of public services that open access to them, forming appropriate digital platforms to support governments, businesses, and the population for greater involvement in the digital economy;
- elimination of limitations that form a digital divide among relevant population groups by implementing inclusive policies;
- development of an accessible digital infrastructure and a reliable digital ecosystem, which requires appropriate solutions and instruments of investment, tax, innovation, and security policies (digital guarantees);
- progress in citizens' digital skills, especially those who are currently generally excluded from digital services and belong to vulnerable categories of the population.

In the modern conditions of a significantly expanded number and varieties of international actors in international economic relations, strengthened by digital technologies, a new international security agenda is developing, focused on the security of the individual within the state, including issues that go beyond traditional concepts of international security. The progressive fragmentation of the rules and regulations governs international political and trade relations. One consequence is the continued weakening of multilateral institutions. However, without the help of international organizations today, it is a daunting task to predict the reduction of the digital divide and social inequality in general.

For countries where the digital divide limits opportunities for economic development, involvement in international partnerships will contribute to the implementation and spread of digital technologies, including through international technical and financial assistance. Increasing the population's digital skills, ensuring data protection and privacy, developing digital infrastructure, and investing in the information and communication spheres expand the possibilities of using digital trade. The introduction of international standards ensures appropriate compatibility of production networks and technologies, increases productivity and strengthens integration into the world production and trade system.

5. Conclusions. The modern digital divide existing between countries around the world has a social and technological basis. Social inequality limits access to technologies, the possibilities of using them, and their benefits. On the other hand, the level of access to technologies and the possibilities of their effective use directly affects the information chain of value creation and thus determine the level of socioeconomic and innovative development, which is important for the diffusion of information technologies, the development of digital infrastructure, the determination of the value of digital technologies, the mastery of digital skills, etc. As a result, digital inequality further reinforces social stratification. Without achieving universal digital communication and connectivity, which is necessary to further ensure digital transformation, it will be difficult to achieve the Sustainable Development Goals.

It is proposed to use a methodical approach consisting of four stages and providing for the systematization of indicators of digital development, their analysis from the point of view of patterns of change, unevenness, and differentiation, the calculation of integral indices of the digital development of regions and their ranking, the calculation of summarizing assessments unevenness and discontinuity to assess the asymmetry of the digital development of the world economy regions. As a consequence of the digital divide, the digital incorporation of low-income countries is forming, which leads to further inequitable distribution of value from accessing and using the benefits of the modern digital economy. Imperfect norms and rules (institutional inequality) by certain groups of users of the digital system (relational inequality) exacerbate such resource inequality.

The rapid spread of digitalization affects the development of countries and humanity, the fate of a particular person. The latest digital technologies not only provide transformation but also create fundamentally new opportunities for their development. On the other hand, unauthorized access to a large amount of information has made the world more vulnerable, which increases information nationalism. From the point of view of involvement in the digital economy, two leaders have already clearly stood out today – the USA and the People's Republic of China, which together dominate various segments of digitalization and whose influence has a planetary scale, which actualizes problematic issues related to the distribution of profits from digitalization. Access to digital technologies remains asymmetric, including for representatives of different generations. The formation of Gen Z coincides with the global spread of digital technologies, which allows us to talk about the first digital generation in mankind's history, which has its specific consumption and is oriented towards post-material values. As a result, the results of digitalization received by Gen Z representatives affect the reduction of opportunities for previous generations, which expands the classical understanding of inequality associated with the comparison of social, economic, and environmental asymmetries between people, groups of people, and countries.

Digital inclusion by addressing the causes of the digital divide will extend the benefits of digital technologies to more people. Achieving this requires concerted joint action by all actors in the digital ecosystem, including through the development of international cooperation and assistance. Using international assistance for implementing educational innovations for least developed countries will contribute to their access to digital technologies (primarily the absolute availability of the Internet), along with its impact on socio-political processes, social relations, communication, and the economy, will entail the final incorporation of Internet access into the international human rights system. The proposed main areas of implementation of digital policies should receive practical implementation in the corresponding policies of sustainable recovery, which ensure the appropriate levels of power, the main of which are: prioritization of the digital transformation of public services; formation of appropriate digital platforms to support governments, businesses, and the population; elimination of restrictions forming a digital divide among relevant population groups; development of accessible digital infrastructure and reliable digital ecosystem; digital skills training. Digitalization strategies implemented by national governments to address this issue are essential to ensuring the competitiveness of national economies.

The use of international aid and involvement in international partnerships will contribute to the introduction and spread of digital technologies, and the participation of all actors in international economic relations in the modern digital system. Accordingly, the formation of a multi-level system of international aid in the modern conditions of digitalization of the economy determines the further direction of research. Digital diplomacy has become a decisive component in the system of diplomatic relations (both official and public), which is reduced to the use of web and information technologies in the implementation of diplomatic tasks, it is not able to replace them but is able to perform an exclusively pragmatic function of quickly filling the information space with objective information.

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Нерівність та асиметрія цифрового розвитку регіонів світу

Стрімке поширення цифровізації впливає на розвиток країн і людства, на долю конкретної людини. Сучасний цифровий розрив, який досліджується у статті, посилює соціальну стратифікацію світового господарства, ускладнює досягнення Цілей сталого розвитку 2030. Нерівність (соціальна й технологічна) для пересічної людини обмежує доступ до технологій, можливостей їх використання і отримання корисності, для людства – гальмує соціально-економічний розвиток, поглиблюючи цифровий розрив. З іншого боку, новітні цифрові технології створюють принципово нові можливості прогресивного розвитку. Усунення причин цифрового розриву розширяє переваги цифрових технологій, що вимагає впровадження цифрових політик у відповідні політики сталого відновлення, узгоджених спільних дій всіх акторів цифрової екосистеми, залучення до міжнародних партнерств, застосування міжнародної допомоги тощо.

У статті проведена комплексна оцінка асиметрії цифрового розвитку регіонів світу із використанням інтегральних показників, оскільки рівень нерівномірності при порівнянні за різними одиничними індикаторами цифрового розвитку суттєво відрізняться. Основними етапами (завданнями) дослідження стали: систематизація показників цифрового розвитку, їх аналіз з точки зору закономірностей зміни, нерівномірності та диференціації, розрахунок інтегральних індексів цифрового розвитку регіонів та їх рейтингування, розрахунок узагальнюючих оцінок нерівномірності та розриву. За інтегральним рівнем цифрового розвитку лідером серед інших регіонів світу залишається європейський регіон має найвищий рівень цифрового розвитку (82%), азійсько-тихоокеанський регіон займає випереджає американський, відповідно 74,56% та 67,67%. Середньосвітовий індекс цифрового розвитку складає 64,21%. Цифровий розрив залишається дуже високим (370,3 рази), що пов'язано зі збереженням відставанням країн африканського регіону у можливостях доступу та використання цифрових технологій.

Ключові слова: інноваційний розвиток; нерівність; цифровізація; цифрові технології; цифровий розрив; цифрова дипломатія; міжнародна допомога; регіони світу.