ОЦЕНКА ЦИФРОВОЙ ТРАНСФОРМАЦИИ ЕВРОПЕЙСКИХ СТРАН С МАЛОЙ ОТКРЫТОЙ ЭКОНОМИКОЙ

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На основе критериев, предложенных профессором Е. Л. Давыденко, выделены европейские страны с малой экономикой. Проведен рейтинговый анализ положения стран с малой экономикой с использованием известных международных индексов, которые характеризуют уровень развития цифровой экономики. Предложена новая формула для расчета усредненного места страны в итоговом рейтинге уровня цифровой трансформации. Рассмотрен уровень цифровой трансформации стран с малой экономикой при помощи кластерного подхода.

Ключевые слова: информационно-коммуникативные технологии; цифровая трансформация; страны с малой экономикой; рейтинг; национальная экономика; инновационное развитие.

ASSESSMENT OF THE DIGITAL TRANSFORMATION OF EUROPEAN COUNTRIES WITH SMALL OPEN ECONOMIES

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The article is based on the criteria proposed by professor E. L. Davydenko, in which European countries with small open economies are selected. A rating analysis of countries with small economies situation based on well-known international indices that characterise the level of digital economy development is carried out. A new formula is proposed for calculating country average position in the final rating of digital transformation level. The analysis of digital transformation level of countries with small economies using the cluster approach is carried out.

Keywords: information and communication technologies; digital transformation; small economy countries; rating; national economy; innovative development.

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The current era is characterised by transition from the industrial to the post-industrial development stage. The material basis of post-industrial civilisation is the knowledge economy. This economy is an innovative type of system that can generate the knowledge necessary for its growth and development. At the same time, the transition is ensured by the large-scale, full-format dissemination and use in all spheres of the modern society of information and communication technologies (hereinafter – ICT), which form the technical and technological core of the future intellectual economy. Over the past 10–15 years, as a result of the nascency (mainly in economically developed countries) of a host of fundamentally new business models and financial schemes based on ICT use, it has become possible to radically increase the efficiency of management and management, competitiveness at micro- and macrolevels. On the agenda is the issue of digital transformation of the economy, both national and global (see details in [1]).

Digital transformation involves the full integration of industry and digital technology to increase efficiency and optimise the process of resource allocation, improving business models and production methods. In response to the deep digital technologies integration in the real economy, not only new, but also traditional industries are constantly developing, new models of development and public administration are being created. Moreover, the digital transformation has led to improved management practices in a number of countries.

Countries with different development levels and economy scale are committing digital transformation. As part of the study of digital transformation issues, the most interesting countries for the Republic of Belarus are countries with small economies, which are more dependent on world conditions and competitiveness closely related to economy digitalisation in foreign markets. In this article, the study of digital transformation features is focused on European countries with small economies, as most of the international digital transformation indices (IMD world digital competitiveness index, Digital evolution index, Global connectivity index and Digital economy and society index) are calculated mainly for these countries.

Previously, countries with small economies were selected from all European countries based on the criteria proposed by professor E. L. Davydenko: the size of the country, as a rule, does not exceed 500 000 km^2, the country's share in world GDP is not more than 1 %, country's GDP does not exceed 5 % of US GDP, population is more than 0.5 mln people, country's population does not exceed 6 % of US population, export quota exceeds global average of 30 % [2, p. 14]. Based on the proposed criteria, Andorra, Vatican, Cyprus, Liechtenstein, San Marino and Monaco were excluded from the analysis.

Analysis results, based on World Bank statistics[1], are presented in table 1.

Table 1

European states classification depending on economy and population size (data for 2019)

Country	Economy size	Population people, mln	Share of US population, %	GDP, mln US dollars	Share of world GDP, %	Share of US GDP, %
Germany	Large	82.1	25.3	3 996 759.3	4.7	19.5
United Kingdom	Large	66.2	20.4	2 825 208.0	3.3	13.8
France	Large	65.0	20.0	2 777 535.2	3.2	13.6
Italy	Large	59.4	18.3	2 073 902.0	2.4	10.1
Spain	Large	46.4	14.3	1 426 189.1	1.7	7.0
Ukraine	Controversial	44.2	13.6	130 832.4	0.2	0.6
Poland	Controversial	38.2	11.8	585 782.9	0.7	2.9
Romania	Controversial	19.7	6.1	239 552.5	0.3	1.2
Netherlands	Controversial	17.0	5.2	913 658.5	1.1	4.5
Belgium	Small	11.4	3.5	531 766.9	0.6	2.6
Greece	Small	11.2	3.5	218 031.8	0.3	1.1
Czech Republic	Small	10.6	3.3	245 225.9	0.3	1.2
Portugal	Small	10.3	3.2	237 978.9	0.3	1.2

[1]DataBank. World Development Indicators // World Bank [Electronic resource]. URL: https://data.worldbank.org/indicator/?tab-featured (date of access: 26.05.2020).

Ending table 1

Country	Economy size	Population people, mln	Share of US population, %	GDP, mln US dollars	Share of world GDP, %	Share of US GDP, %
Sweden	Small	9.9	3.1	551 031.7	0.6	2.7
Hungary	Small	9.7	3.0	155 703.1	0.2	0.8
Belarus	Small	9.5	2.9	59 662.5	0.1	0.3
Austria	Small	8.7	2.7	455 736.6	0.5	2.2
Switzerland	Small	8.5	2.6	705 501.3	0.8	3.4
Bulgaria	Small	7.1	2.2	65 133.0	0.1	0.3
Serbia	Small	8.8	2.7	50 508.4	0.1	0.2
Denmark	Small	5.7	1.8	352 058.4	0.4	1.7
Finland	Small	5.5	1.7	237 961.0	0.3	1.2
Slovakia	Small	5.4	1.7	106 472.2	0.1	0.5
Norway	Small	5.3	1.6	434 750.9	0.5	2.1
Ireland	Small	4.8	1.5	382 487.5	0.4	1.9
Croatia	Small	4.2	1.3	60 805.7	0.1	0.3
Moldova	Small	4.1	1.3	11 309.1	0.0	0.1
Bosnia and Herzegovina	Small	3.5	1.1	19 781.8	0.0	0.1
Albania	Small	2.9	0.9	15 058.9	0.0	0.1
Lithuania	Small	2.9	0.9	53 251.4	0.1	0.3
North Macedonia	Small	2.1	0.6	12 672.1	0.0	0.1
Slovenia	Small	2.1	0.6	54 235.5	0.1	0.3
Latvia	Small	1.9	0.6	34 849.1	0.0	0.2
Estonia	Small	1.3	0.4	30 284.9	0.0	0.1
Montenegro	Small	0.6	0.2	5452.2	0.0	0.0
Luxembourg	Small	0.6	0.2	69 487.9	0.1	0.3
Malta	Small	0.4	0.1	14 542.0	0.0	0.1
Iceland	Small	0.3	0.1	25 882.2	0.0	0.1

N o t e. Indicators of country as a country with a small economy are marked in blue.

As can be seen from the above, 29 countries can be unambiguously attributed to European countries with small economies. At the same time, four countries remain controversial as of 2019 (Netherlands, Poland, Romania, Ukraine).

All European countries with small economies are represented in the matrix in figure 1.

All small European countries can be divided into four subgroups:

• countries with a significant share of GDP and population (Switzerland, Belgium, Austria, Sweden, Norway, Ireland, Denmark, Finland);

• countries with a relatively large share of GDP and population (Czech Republic, Hungary, Belarus, Bulgaria, Slovakia, Portugal, Greece, Croatia, Serbia);

• countries with a relatively small share of GDP and population (Lithuania, Latvia, Estonia, Moldova, the former Yugoslavia);

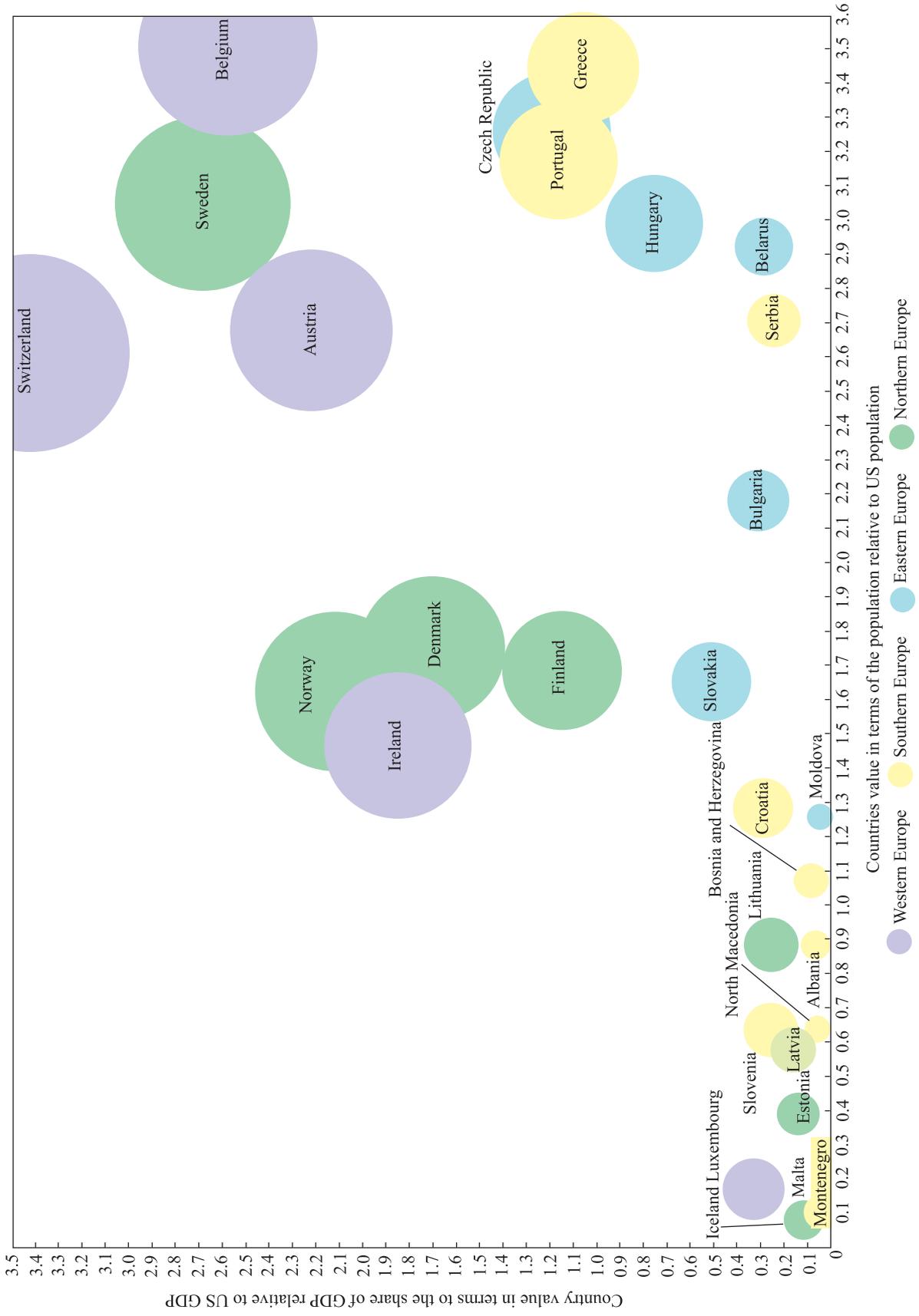• countries with a small share of GDP and population (Iceland, Luxembourg).

Fig. 1. Significance matrix of small European countries in total GDP and population

It should be noted that the digital development of countries with a small open economy at this stage has its own specific features in the possession and retention of competitive advantages in the long term.

The development level of the digital transformation and the country's rating are measured on the basis of various composite indices integrating individual sub-indices responsible for individual digital transformations. The sub-indices values show the development level of country (geographical region) in the area of digital economy.

Well-known indices that characterise the development level of digital economy are considered in the work:
• ICT development index (IDI) [3];
• Digital economy and society index (DESI)[2];
• IMD world digital competiveness index (WDCI)[3];
• Digital evolution index (DEI) [4];
• Networked readiness index (NRI) [5];
• The UN global e-government development index (EGDI) [6];
• E-participation index (EPART) [6];
• Global connectivity index (GCI, Huawei)[4];
• The global innovation index (GII) [7].

The places of European countries with small economies in the latest ratings of digital economy development are presented in table 2.

T a b l e 2

European countries in the latest ratings of digital economy development (2017–2019)

Country	IDI 2017	DESI 2019	WDCI 2019	DEI 2017	NRI 2019	EGDI 2018	EPART 2018	GCI 2019	GII 2019
Austria	21	13	20	19	15	20	45	19	21
Albania	89	–	–	–	75	74	59	–	83
Belarus	32	–	–	–	61	38	33	47	72
Belgium	25	9	25	18	20	27	59	20	23
Bulgaria	50	27	45	41	49	47	35	34	40
Bosnia and Herzegovina	83	–	–	–	81	105	125	–	76
Hungary	48	23	43	32	38	45	69	31	33
Greece	38	26	53	38	43	35	34	38	41
Denmark	4	4	4	4	6	1	1	5	7
Ireland	20	6	19	16	19	22	22	18	12
Iceland	1	–	27	–	21	19	75	–	20
Latvia	35	17	36	28	39	57	75	–	34
Lithuania	41	14	30	–	31	40	51	28	38
Luxembourg	9	6	21	–	11	18	19	16	18
Malta	24	10	–	–	26	30	39	–	27
Moldova	59	–	–	–	66	69	37	–	58

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[2]Digital economy and society index // European Commission [Electronic resource]. URL: https://digital-agenda-data.eu/datasets/desi/visualizations (date of access: 26.05.2020).

[3]IMD world digital competitiveness ranking 2019 // IMD World Competitiveness Centre [Electronic resource]. URL: https://www.imd.org/contentassets/6b85960f0d1b42a0a07ba59c49e828fb/one-year-change-vertical.pdf (date of access: 25.05.2020).

[4]Powering intelligent connectivity with global collaboration. Mapping your transformation into a digital economy with GCI 2019 // Huawei [Electronic resource]. URL: https://www.huawei.com/minisite/gci/en/index.html (date of access: 26.05.2020).

Country	IDI 2017	DESI 2019	WDCI 2019	DEI 2017	NRI 2019	EGDI 2018	EPART 2018	GCI 2019	GII 2019
Norway	7	–	9	1	4	14	11	8	19
Portugal	44	18	34	24	28	29	30	24	32
North Macedonia	69	–	–	–	65	79	71	–	59
Serbia	55	–	–	–	52	49	48	53	57
Slovakia	46	21	47	33	35	49	50	32	37
Slovenia	33	16	32	29	27	37	48	29	31
Finland	22	1	7	5	7	6	1	7	6
Croatia	36	20	51	–	44	55	57	39	44
Montenegro	61	–	–	–	–	58	64	–	45
Czech Republic	43	19	37	27	30	54	92	25	26
Switzerland	3	–	5	3	5	15	41	2	1
Sweden	11	2	3	2	1	5	19	3	2
Estonia	17	8	29	21	23	16	27	21	24
Total place in rating	176	28	63	60	121	193	193	79	129

After studying the key indices, it is possible to calculate the place of each European country with a small economy in the overall ranking of digital transformation in 2019. The average rating cannot be calculated using the arithmetic mean method, because does not consider several key points:

• different number of countries in different ratings: there is a difference in the fact that a country took 4th place among 28 or among 193 participants;

• country's place change in a particular rating depending on year, i. e. country's movement direction and pace towards the digital economy;

• participation of each country in several ratings, moreover, during the year different countries take part in a different number of ratings.

Given above features, the formula for calculating an average place N in the final rating is the following:

$$N = \frac{\sum_{i=1}^{m}\left(\frac{\ln \cdot n}{\ln(i+1)} \cdot e^{\frac{\Delta i}{n}}\right)}{m},$$

where i – country place in the current ranking; n – total number of countries in the current ranking; e – Eulerian number; Δi – difference between the country's places in the previous and current ratings; m – total number of ratings, in which the country participates in the current year.

It is important to note the possibility of the following situation: the country is present in the ranking of this year, but it is absent in the last year, and vice versa. As an example, it can be taken Latvia and Bulgaria, which took 28th and 41st places, respectively in the DEI 2017 ranking (total number of places is 60), but absented in DEI 2014 (total number of places is 50). Or, as an another example, it can be cited Belarus, which was not included in the NRI 2016 rating (where 139 countries were present), however in the NRI 2019 rating the country took 61st position out of 121. Thus, for the correct calculation of the total rating it should be assigned the 25th place for Latvia and Bulgaria in DEI 2014, as well as the 69th place for Belarus in NRI 2016, i. e. the average values in respective ratings.

For calculations, an additional table 3 was compiled, which shows the places of small European countries in the penultimate ratings of digital economy development.

Table 3

European countries in the penultimate ratings of digital economy development (2014–2018)

Country	IDI 2016	DESI 2018	WDCI 2018	DEI 2014	NRI 2016	EGDI 2016	EPART 2016	GCI 2018	GII 2018
Austria	24	12	15	10	20	16	14	20	21
Albania	89	–	–	–	84	82	55	–	83
Belarus	31	–	–	–	–	49	76	42	86
Belgium	23	9	23	20	23	19	55	20	25
Bulgaria	53	26	43	–	69	52	43	43	37
Bosnia and Herzegovina	81	–	–	–	97	92	89	–	77
Hungary	49	23	46	44	50	46	91	30	33
Greece	38	27	53	41	70	43	65	34	42
Denmark	3	3	4	11	11	9	22	7	8
Ireland	19	8	20	16	25	26	39	16	10
Iceland	2	–	21	–	16	27	50	–	23
Latvia	40	17	35	–	32	45	84	–	34
Lithuania	41	14	29	–	29	23	17	24	40
Luxembourg	9	6	24	–	9	25	43	13	15
Malta	25	10	–	–	34	30	25	–	26
Moldova	63	–	–	–	71	65	50	–	48
Norway	10	–	6	14	4	18	27	9	19
Portugal	44	18	32	26	30	38	50	25	32
North Macedonia	68	–	–	–	46	69	65	–	84
Serbia	55	–	–	–	75	39	17	53	55
Slovakia	47	20	50	36	47	67	82	31	36
Slovenia	33	16	34	28	37	21	37	26	30
Finland	21	4	7	7	2	5	8	6	7
Croatia	42	21	44	–	54	37	25	35	41
Montenegro	56	–	–	–	51	47	17	–	52
Czech Republic	39	19	33	31	36	50	76	29	27
Switzerland	4	–	5	5	7	28	72	4	1
Sweden	8	2	3	2	3	6	27	3	3
Estonia	14	7	25	24	22	13	22	22	24

According to the formula, the average ratings of small European countries were calculated according to the level of digital development in 2017–2019 (table 4).

Table 4

Rating of small European countries in terms of digital development using a new method of calculation

Place	Country	Country index	Europe region
1	Denmark	3.825 46	Northern Europe
2	Sweden	3.469 08	Northern Europe
3	Switzerland	3.326 53	Western Europe
4	Finland	3.190 41	Northern Europe
5	Norway	2.810 22	Northern Europe
6	Iceland	2.442 25	Northern Europe
7	Luxembourg	1.775 25	Western Europe
8	Ireland	1.657 71	Western Europe
9	Estonia	1.507 05	Northern Europe
10	Malta	1.477 70	Southern Europe
11	Austria	1.452 11	Western Europe
12	Belgium	1.451 44	Western Europe
13	Belarus	1.390 00	Eastern Europe
14	Portugal	1.385 29	Southern Europe
15	Greece	1.329 98	Southern Europe
16	Slovenia	1.316 65	Southern Europe
17	Slovakia	1.314 21	Eastern Europe
18	Hungary	1.311 30	Eastern Europe
19	Czech Republic	1.283 29	Eastern Europe
20	Lithuania	1.269 71	Northern Europe
21	Moldova	1.268 88	Eastern Europe
22	Latvia	1.263 60	Northern Europe
23	Bulgaria	1.254 53	Eastern Europe
24	Serbia	1.241 34	Southern Europe
25	Croatia	1.198 11	Southern Europe
26	Albania	1.193 65	Southern Europe
27	North Macedonia	1.192 49	Southern Europe
28	Montenegro	1.191 30	Southern Europe
29	Bosnia and Herzegovina	1.096 28	Southern Europe

It is necessary to pay attention to the dependence of the digital development level on the region, in which the country is located (based on the results of the rating).

According to the UN nomenclature, European countriesare divided into four main regions: Western, Eastern, Northern and Southern Europe. For clarity, these countries are highlighted in different colors in table 4.

It can be observed that the Scandinavian countries of Northern Europe got the highest scores (the first five out of six places of the rating), then there is a cluster of Western European countries, the «old» countries of Southern Europe (Malta is the leader) are lower in the rating, the countries of Eastern Europe are in the middle of the rating, the minimum scores have countries of Southern Europe located in the west of the Balkan Peninsula (the former Yugoslavia). Lithuania and Latvia, related to Northern Europe, are significantly inferior to the Scandinavian countries in terms of points, but Estonia is actively competing with them and is improving

its position in the digitalisation race every year. The Republic of Belarus, occupying 17th place, is one of the leaders among Eastern European countries.

It should be noted the high level of digitalisation of small European countries in Northern Europe: Denmark, Sweden, Finland, Iceland and Norway. In this race, they were able to break far ahead of many large developed countries, continuing to set themselves more and more ambitious goals and objectives.

Based on the high digitalisation rates of the economies of the Scandinavian countries, one cannot but wonder: why these relatively small countries with a small population and, according to historians, which lagged behind in development from countries with «classical capitalism» for a long time, could become universally recognised innovation centres in Europe and continue to hold leading positions for more than 10 years?

The reason for this can be called an effective government policy, focused on building effective innovation systems based on triple helix and quadruple helix, the distribution of a significant share of the state budget expenditures on R&D, support and stimulation of digital transformation processes by goverment. Triple helix principle can be interpreted as the interaction of innovative efforts of the state, business and the education sector (primarily universities). In recent years, researchers have noticed a significant impact on innovative processes from the various social sectors, which can be called quadruple helix. As a result, it becomes even more effective interaction, as the support of the population can contribute to the speedy construction of an innovative economy. However, in practice, quadruple helix principle is implemented only in Northern Europe countries, where various social groups actively participate in creation and implementation of digital development models. The main reason for this phenomenon is the significant role of the population of the Scandinavian countries in building a welfare state. Society is the basis of all changes in these countries, both internal and external, the basis for solving all problems (social, economic and environmental).

All Northern European countries are characterised by a strategy that defines goals and directions of digitalisation and bases on economic interests and the provides better living conditions for the population through digital technologies using.

For example, the basis for building the digital economy in Denmark was Digital strategy 2016–2020, according to which the Danish government committed itself to becoming digital by default. Interestingly, the strategy was written in English: this confirms the willingness of Denmark to become an international center for business digitalisation. Due to Digital strategy for 2016–2020 (hereinafter – strategy) Denmark continues to evolve along the path of digital governance, communications and electronic services. The specific areas of this Strategy are the following: a convenient and simple digital public sector; more efficient use and faster data processing; improving platform for the business community; public data sector presence as a growth factor; an efficient utilities sector; data protection in the public sector; sustainable digital infrastructure and digitisation for everyone. The Strategy emphasises the need for close cooperation of public sector with business, interested organisations and other actors in laying the foundation for a flexible and adaptive society, ready to create an increasingly digitalised world.

European experts on digital transformation believe that key factors of Denmark's competitiveness are development of high-speed mobile communications, widespread use of Internet, including provision of Internet services, population «familiarisation» with digital innovations, number of IT specialists, and active use of digital technologies in business sphere. Based on Digital growth strategy of Denmark for 2018–2025 adopted in January 2018 measures are being taken to correlate the processes of education and vocational training at various levels with the needs of the business sector.

The basis of Swedish economy digitalisation is Digital strategy, which was developed in 2017. It includes several main areas of development: improving digital literacy, ensuring security, stimulating creation and implementation of innovations, leadership, and infrastructure developing. In addition, the National cybersecurity strategy was adopted and many new digital projects were implemented in Sweden in 2017, e. g., the SmartCoding is a project that will help ensure gender equality in the IT field, helping women learn programming. Also there are regional and local strategies for certain aspects, for example, in terms of connecting to the Internet. In addition, Sweden can boast of the rapid growth in the digital services trade, significant investment in knowledge and stimulation of innovation, as well as the creation of new business models using big data and artificial intelligence technologies.

The first large-scale document in the field of Finnish economy digitalisation was «Productive and innovative Finland. Action plan in the field of digital technologies for 2011–2020». This plan was adopted back in 2011. Principally, Finland was one of the first countries that, at the highest level, drew attention to the importance and prospects of digitising its economy. The key objectives of this plan were to ensure public access to public data and its effective use, development of user-oriented services, providing older people the opportunity to lead an active lifestyle, sustainable development through the development of new technologies. The peculiarity of Finnish economy digitalisation lies in the fact that it is carried out in conditions of a high level of social

responsibility (from protecting the environment to equal rights and opportunities for citizens) and stimulates the «smart» digitalisation available to all citizens. Digital skills possession, fixed and mobile communications, the Internet and Internet services use, state-owned digital services development, as well as digital technologies integration in business are Finland's main competitive advantages. National program for the development of artificial intelligence was adopted in 2017 to achieve the country's leadership in artificial intelligence use.

Norway adopted several agendas for the information society and (or) digital government (e. g., eNorway plans) between 2005 and 2017. Although each of these programme documents emphasised different orientation, reflecting different views on problems based on changing political priorities, and defined different goals, these programs relied on achievements and general problematic issues. As a result, this interconnected model has ensured continuity in the process of developing and implementing policies. So that Norway becomes one of the leading countries in the creation of digital government.

The current Digital agenda for Norway (also known as White paper), introduced by the government in 2016, emphasises the need to use digital technology to modernise and simplify processes in the public sector, as well as ICT and digitalisation are seen as tools to ensure strategic competitive advantage country. To improve the quality of citizens life and enterprises work and productivity, the following priorities of the government (Ministry of Local Government and Regional Development of Norway) are defined in the White paper:

• user focus: use of technologies that provide high-quality and integrated public services for citizens and simplify everyday life;

• ICT as a significant contribution to innovation and productivity: digitise government operations in ways that support overall digital innovation and business competitiveness;

• fostering digital competency and inclusiveness: continuous improvement of digital competence and inclusiveness at all life stages and in all population groups (e. g., migrants, refugees);

• effective public sector digitalisation: digital technology introduction in public sector reform in order to reduce management complexity level and provide user-friendly digital services. Common solutions development and promotion of its use in central and local authorities, as well as ensuring compatibility with European solutions;

• reliable data protection and information security: data protection and security consideration as integrated elements of ICT development and use. Citizens need to have operational control over own data. Securing ICTs to maintain confidence in digital solutions.

The Norwegian government plans to increase investment in educational programmes. In the near future, the following promising aspects will be considered: creation of a large number of educational institutions with best practices in the field of ICT, promoting expansion and strengthening of scientific community in the field of ICT, strengthening ICT research based on a long-term research and higher education plan, well-defined technological perspective inclusion in basic education.

The Scandinavian countries governments understand that in order to ensure stable and successful economy development, it is necessary to enable population to play a leading role in production and distribution of material goods. Human capital is not only a combination of knowledge and skills, but also investments in improving population welfare, encouraging citizens to engage in self-education, generate new ideas, develop innovations that contribute to production sphere development. All this can be achieved only if the government takes all measures to achieve maximum results in the direction of digital economy formation and development. Therefore, the Republic of Belarus, which wants to improve performance in ratings and indices, needs to correctly prioritise to build a digital economy.

Библиографические ссылки

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