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COMPARATIVE ANALYSIS OF THE COMPETITIVENESS OF UKRAINE'S ICT SECTOR: AN INTERNATIONAL PERSPECTIVE

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Abstract. The *purpose of the paper* is to examine the international competitiveness of Ukraine's ICT sector through a comparative analysis with 30 countries, identify its strengths and weaknesses, and provide actionable insights for policymakers, industry stakeholders and investors to improve Ukraine's position in the global ICT market. *Methodology.* The research employs the composite index methodology to assess the international competitiveness of Ukraine's information and communication technology (ICT) sector. The original ITSIC comprises 35 indicators; however, this has been expanded to 58 in order to provide a comprehensive view of the competitive advantages and position of the ICT sector in the global ICT market. *Results.* The article presents the findings of a comparative study of the ICT sector of Ukraine with global and regional leaders in the global ICT market. In order to identify the factors influencing the formation of competitive advantages, the following groups of factors were taken into account: the state of ICT infrastructure, the availability of qualified and competent IT professionals, the state and favourability of the political and business environment, the innovative potential of the ICT sector and its involvement in international trade and cooperation. The calculations have yielded the ratings for each group of indicators and the composite index as a whole, which identify the leaders in both global and regional dimensions. Specific consideration is given to the positioning of Ukraine's ICT sector within the context of the surveyed countries, with a focus on the identification of its competitive advantages and disadvantages within the global ICT market. Consequently, it has been determined that the international competitiveness of the domestic ICT sector between 2018 and 2022 was most significantly influenced by the extent of its involvement in international trade and collaboration, the availability and proficiency of the talent pool, and the quality of the ICT infrastructure. In conclusion, this study has identified the factors and trends that have the potential to impede Ukraine's ascension as a global leader in the ICT sector. *Practical implications.* The findings of the study may prove beneficial to a number of parties, including public authorities, ICT companies, investors and venture capitalists, educational and research institutions, international organisations and development agencies, IT entrepreneurs and the general public. The *value and originality of the study* can be found in its comprehensive, data-driven, and context-specific analysis, which provides actionable insights and strategic recommendations to enhance the international competitiveness of Ukraine's ICT sector.

Keywords: ICT sector, competitiveness, competitive advantages, ICT services, IT specialist, ICT market, comparative analysis.

JEL Classification: F10, F20, L86, O57

1. Introduction

The international competitiveness of a country's ICT sector represents a pivotal determinant of its economic growth and development. The scientific community's interest in researching the dynamics, challenges, and opportunities shaping Ukraine's ICT sector reflects the growing importance, innovation potential, and impact on economic and social dynamics of this sector. For example, research has been conducted by I. A. Bulkina, M. S. Rakhman, S. O. Korabelskiy, O. Zayats, I. Khomenko, E. Zavhorodnya, T. Melnyk, and others. Nevertheless, a prevalent critique of extant

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research on Ukraine's ICT sector is its pronounced Ukraine-centricity, which constrains the scope and depth of analysis. Consequently, researchers are striving to present a comprehensive and objective evaluation of Ukraine's competitive advantages and disadvantages within the global ICT market. The main shortcomings in assessing the international competitiveness of Ukraine's ICT sector are: (1) the lack of a standardised framework for evaluating the performance of the Ukrainian ICT sector against international benchmarks, which weakens the validity of research findings and hinders the identification of key areas for improvement and strategic decision-making; (2) the focus on internal factors within the Ukrainian ICT sector, which can lead to a limited understanding of the broader international context in which it operates; (3) the failure to situate the Ukrainian ICT sector in the broader global context, which leads to a lack of understanding of the complex dynamics shaping the global ICT landscape.

The objective of this research is to conduct a comprehensive comparative analysis of the international competitiveness of Ukraine's ICT sector relative to 30 countries. This analysis will identify Ukraine's competitive advantages and disadvantages in the global ICT landscape. Benchmarking Ukraine's ICT sector against different countries can provide valuable insights into the competitiveness and performance of Ukraine's ICT sector for several reasons: (1) benchmarking Ukraine's ICT sector against 30 different countries provides a holistic understanding of its strengths, weaknesses, opportunities and threats in the global marketplace in order to identify areas where Ukraine can improve its international competitiveness in the ICT sector; (2) comparing the Ukrainian ICT sector with countries known for their advanced technologies and innovations (e.g., the United States, Japan, and the Republic of Korea) can help identify areas where Ukraine can improve and adopt best practices. On the other hand, comparisons with emerging technology hubs (e.g., India and Malaysia) can provide inspiration for potential growth strategies; (3) benchmarking Ukraine's ICT sector against European countries can provide insights into regional trends and opportunities for cooperation or competition within the European technology landscape (e.g., identifying commonalities with EU countries can lead to closer integration into European technology initiatives); (4) comparing Ukraine's regulatory environment with these countries can help identify areas for alignment and potential regulatory reforms to foster a more competitive and innovative technology industry; (5) assessing Ukraine's ICT sector in comparison to global players can also inform the attraction of foreign investment and talent, as well as demonstrate strengths and potential for growth, making Ukraine more attractive to international technology companies and skilled professionals.

2. Methodology

The study's objective is to employ the composite index methodology, as proposed by Melnyk & Zavhorodnya (2023), to assess the international competitiveness of Ukraine's ICT sector. It should be noted that the original ITSIC consists of 35 indicators divided into 5 thematic sub-indices, each of which focuses on assessing important aspects of the competitiveness of the ICT sector, in particular ICT infrastructure (ICTI), human capital (HCI), regulatory and business environment (BREI), R&D activity (RDI), and integration of the ICT sector in the international digital landscape (ITII). Nevertheless, in order to gain a comprehensive understanding of the competitive advantages and positioning of the Ukrainian ICT sector in the global ICT market, it was decided that the original ITSIC should be expanded to include 58 indicators, as illustrated in Table 1.

To calculate each sub-index and the composite Index of International Competitiveness in the ICT Sector (ITSIC), open statistical resources from international governmental and non-governmental organisations were used, in particular ITU, World Bank, Cable.co.uk, UNDP, Fund for Peace, UNESCO, OECD, Coursera, ILO, EF EPI, The Heritage Foundation, Property Rights Alliance, Trading Economics, Transparency International, WIPO, Scimago, UNCTAD and WTO.

The logic and approach to comparison and calculation in the modified ITSIC remained unchanged from the original index by (Melnyk & Zavhorodnya, 2023), in particular: (1) comparison of the sample of countries for the study; (2) normalisation of the selected indicators to bring them into the same unit of measurement; (3) weighting of the selected indicators according to their relative importance; (4) aggregation of the normalised and weighted indicators into a composite index.

3. International Rankings of ICT Sector Competitiveness: ITSIC Perspective

3.1. Comparative Assessment of ICT Infrastructure in the World

The international competitiveness of a country's ICT sector depends to a large extent on the reliability of its ICT infrastructure, especially in terms of accessibility (e.g., the ease with which individuals, businesses and institutions can connect to and use ICT services), ubiquity (the ubiquitous presence and availability of ICT services throughout the country) and reliability (the consistency and reliability of ICT service delivery).

Table 1
Modified Structure of ICT Sector International Competitiveness Index (ITSIC)

Sub-index	Number of indicators	Indicators (explained)
ICTI	21	Active mobile-broadband subscriptions per 100 inhabitants, fixed broadband subscriptions (>10 Mbit/s), fixed broadband subscriptions per 100 inhabitants, households with a computer at home, households with Internet access at home, individuals using the Internet, monthly fixed broadband Internet traffic per fixed broadband subscription, monthly mobile broadband Internet traffic per mobile broadband subscription, total fixed broadband subscriptions, population covered by a mobile-cellular network, population covered by at least a 3G mobile network, population covered by at least a 4G mobile network, fixed broadband basket as a % of GNI p.c., mobile broadband basket as a % of GNI p.c., mobile cellular basket as a % of GNI p.c., mobile data and voice basket (high consumption) as a % of GNI p.c., mobile data and voice basket (low consumption) as a % of GNI p.c., average cost of broadband Internet access, average cost of mobile Internet access, mean download speed and secured Internet servers.
HCI	13	Human Development Index, Brain Drain Index, Adult Literacy Rate, Education Expenditure (% of GDP), Education Expenditure (% of Government Expenditure), Number of Highly Qualified Employed, PISA Maths Results, Population with Advanced ICT Skills (%), Business Skills Ranking, Technology Skills Ranking, Data Science Ranking, English Language Proficiency Index.
BREI	13	Corruption Perceptions Index, International Property Rights Index, Economic Freedom Index, Regulatory Quality Index, Government Effectiveness Index, Political Stability Index, Government Technology Maturity Index (GTMI), ICT Regulatory Tracker, Global Cybersecurity Index, corporate tax rate, social security rate for companies, social security rate for employees, sales tax rate.
RDI	5	Researchers per million inhabitants, gross domestic expenditure on R&D (GERD) as a percentage of GDP, the number of issued patents in ICT, high-tech export, number of scientific works in ICT.
ITII	6	Exports of ICT goods (million USD), imports of ICT goods (million USD), exports of ICT services (million USD), imports of ICT services (million USD), membership in the WTO and OECD.

Source: expanded on the basis of (Melnyk & Zavhorodnya, 2023)

The results of the calculations show (Table 2) that in 2022, the leadership in building and developing a stable and powerful digital infrastructure belonged to such countries as Hong Kong, Singapore, Lithuania, Finland, Estonia, and Poland. In addition, in 2022, the Baltic States had a relatively significant advantage in terms of the quality and reliability of digital infrastructure, followed by Western, Southern and Northern Europe, Asia, the United States and Eastern Europe.

It is worth noting that all the countries in the sample have a well-developed infrastructure, including 99.6% of the territory on average covered by mobile cellular communications, 99.2% by 3G networks and 98.5% by 4G networks. In addition, countries in the Asian region have the highest mobile cellular coverage rates (99.6% on average), with 3G at 99.2% and 4G at 98.7%. In other regions, the prevalence of Internet connection was as follows: (1) Baltic States – mobile cellular communication (99.7% of the territory), 3G (99.7%), 4G (98%); (2) Eastern Europe – mobile cellular communication (99.8% of the territory), 3G (99.3%), 4G (98. 5%); (3) Western, Southern and Northern Europe – mobile cellular communication (99.6% of the territory), 3G (99.2%), 4G (98.6%); (4) the USA and Mexico – mobile cellular communication (98.2% of the territory), 3G (97.9%), 4G (97.4%).

As for the leaders and laggards among the countries in the survey sample in terms of other important indicators of ICT infrastructure development, prevalence, demand and quality, the following can be noted:

– The leaders in terms of average Internet speed were the Baltic States (79.1 Mbit/s on average in the region), the relative outsiders were Eastern European countries (50.9 Mbit/s), and the countries with the highest average data download speed were Japan (122.3 Mbit/s), France (120 Mbit/s) and the United States (118 Mbit/s);

– the largest number of households were connected in Asian countries – an average of 96.1% (the largest share of households with Internet access was in the Republic of Korea (100%), Singapore (98.7%) and Finland (97.6%));

– the largest number of Internet users is concentrated in the Asian region – 1.96 billion people (24.6% of the world's population), Mexico and the United States – 423.8 million people (5.3%), Western, Southern and Northern Europe – 293.7 million people (3. 7%), in Eastern Europe – 238 million people (3%) and the Baltic States – 5.4 million people (0.1%); in addition, China (1.07 billion people), India (681.7 million people), and the United States (323.6 million people) were the leading countries in the world;

– mobile broadband was most widespread in the Baltic States (154.3 active subscriptions per 100 people on average), Asia (138.2), Mexico and the United States (133.8), Western, Southern and

Table 2
ICT Infrastructure Sub-Index Results in 2018-2022*

Country	2018		2019		2020		2021		2022	
	ICTI	Rank	ICTI	Rank	ICTI	Rank	ICTI	Rank	ICTI	Rank
Bulgaria	0,429	26	0,460	27	0,420	27	0,442	26	0,492	22
China	0,528	17	0,557	19	0,599	5	0,579	11	0,534	17
Estonia	0,556	11	0,611	9	0,605	4	0,614	6	0,640	5
Finland	0,616	4	0,663	4	0,635	3	0,654	3	0,641	4
France	0,542	13	0,585	12	0,518	22	0,537	18	0,560	13
Germany	0,488	21	0,574	15	0,543	16	0,592	8	0,602	7
Hong Kong	0,648	1	0,686	1	0,693	1	0,682	1	0,699	1
Hungary	0,451	24	0,482	25	0,518	23	0,496	22	0,486	23
India	0,308	30	0,386	28	0,261	31	0,308	29	0,283	29
Ireland	0,515	19	0,521	22	0,480	25	0,420	27	0,379	28
Israel	0,530	16	0,574	14	0,576	10	0,587	10	0,441	26
Italy	0,555	12	0,562	18	0,536	18	0,547	16	0,555	14
Japan	0,573	8	0,614	8	0,553	15	0,472	24	0,472	24
Latvia	0,458	23	0,583	13	0,556	14	0,545	17	0,582	10
Lithuania	0,585	6	0,603	11	0,583	9	0,630	4	0,649	3
Malaysia	0,435	25	0,461	26	0,462	26	0,455	25	0,494	21
Mexico	0,337	29	0,324	31	0,272	30	0,229	31	0,279	30
Moldova	0,307	31	0,325	30	0,384	28	0,392	28	0,438	27
Poland	0,570	9	0,603	10	0,568	11	0,619	5	0,611	6
Romania	0,501	20	0,529	20	0,520	21	0,558	13	0,564	12
Russia	0,424	27	0,509	23	0,491	24	0,517	19	0,507	19
Singapore	0,635	3	0,678	3	0,641	2	0,667	2	0,682	2
Sweden	0,528	18	0,625	7	0,588	8	0,590	9	0,602	8
Switzerland	0,556	10	0,573	16	0,528	19	0,558	14	0,513	18
The Czech Republic	0,534	14	0,497	24	0,538	17	0,494	23	0,536	16
The Netherlands	0,584	7	0,633	6	0,565	13	0,551	15	0,536	15
The Republic of Korea	0,590	5	0,643	5	0,595	7	0,605	7	0,584	9
The Slovak Republic	0,475	22	0,523	21	0,522	20	0,499	21	0,448	25
The UK	0,531	15	0,566	17	0,595	6	0,571	12	0,567	11
The USA	0,639	2	0,680	2	0,568	12	0,514	20	0,501	20
Ukraine	0,344	28	0,342	29	0,303	29	0,254	30	0,177	31

Source: calculated and compiled on the basis of (ITU, 2024; The World Bank, 2024; Cable.co.uk, 2024)

** the latest available data is presented*

Northern Europe (117) and Eastern Europe (110); with the highest levels of mobile broadband consumption in Japan (234.4 subscriptions per 100 people), Estonia (209.6) and Poland (202.7), while the lowest levels were in Hungary (81.6), India (56.4) and Ukraine (47.2);

– the cheapest access to mobile broadband was in Eastern Europe, at an average of 1.1 USD per month, while the most expensive was in the United States and Mexico (4.3 USD per month);

– the consumption of fixed broadband services in 2022 was an order of magnitude lower: in Western, Southern and Northern Europe, the average number of subscriptions per 100 people was 40.6, in the Baltic States – 32.1, in Asia – 30.9, in Eastern Europe – 30.8, and in the US and Mexico – 29.2;

– the cheapest access to fixed broadband was in Eastern Europe, at an average of 12.8 USD per month, while the most expensive was in Western, Southern and Northern Europe (40.1 USD per month).

As of the end of 2022, Ukraine (99.9%) had a relative advantage in mobile cellular coverage over the Czech Republic, India, Hungary, Russia, the Netherlands, Ireland, France, and others; at the same time, in 2021, Ukraine ranked last in the study sample in terms of 3G network coverage (91.6%), and was only ahead of Ireland (91.6%) in terms of 4G network coverage. In addition, Ukraine ranked 21st in the sample in terms of average data download speed (47.7 Mbps), ahead of Russia, Israel, Italy, Hungary, Czech Republic, India, Mexico, Bulgaria, Slovakia and China. In addition, the average annual cost of mobile broadband services in Ukraine was 0.43 USD per month. The average annual cost of access to mobile broadband in Ukraine was 0.43 USD per month, second only to Israel, Italy, India, France, Moldova,

Poland and China, while the average annual cost of access to fixed broadband was 7.4 USD per month, the lowest in the world. This was the lowest in the sample of countries surveyed. However, it should be emphasised that the study of the state of ICT infrastructure and Internet penetration in Ukraine is methodologically complicated due to the full-scale war with Russia and the occupation of Ukraine's sovereign territories by the aggressor.

3.2. Comparative Assessment of ICT Talent in the World

The human capital of a country, which encompasses the skills, knowledge, and abilities of its workforce, is a crucial determinant of its capacity to innovate, adapt, and lead in the field of ICT on a global scale. This significance can be investigated through two principal dimensions: the general condition of human capital and ICT-specific talent. Countries that invest in education, retain skilled professionals, and cultivate advanced ICT skills, language proficiency, and business acumen among their workforce establish themselves as leaders in the global ICT landscape. This dual focus on comprehensive educational quality and specialised ICT capabilities is vital for maintaining and enhancing a country's competitive advantage in the international ICT market.

The results of the calculations, as presented in Table 3, indicate that in 2022, Germany, the Netherlands, Singapore, Finland, France, and the Republic of Korea were the global leaders in terms of the availability of a highly skilled talent pool for the ICT sector. Conversely, Moldova, Russia, and India exhibited a comparatively inferior level of talent availability when compared to the other countries

Table 3
Human Resources Sub-Index Results in 2018-2022*

Country	2018		2019		2020		2021		2022	
	HCI	Rank	HCI	Rank	HCI	Rank	HCI	Rank	HCI	Rank
Bulgaria	0,249	28	0,236	29	0,424	24	0,441	21	0,369	19
China	0,299	26	0,324	27	0,418	25	0,381	26	0,341	25
Estonia	0,379	19	0,433	18	0,553	9	0,545	8	0,379	18
Finland	0,694	3	0,715	2	0,690	2	0,676	1	0,554	4
France	0,576	9	0,628	7	0,520	12	0,608	7	0,537	5
Germany	0,598	7	0,646	6	0,649	5	0,639	6	0,589	1
Hong Kong	0,440	16	0,453	17	0,487	17	0,441	20	0,469	10
Hungary	0,496	13	0,474	15	0,483	19	0,467	18	0,348	24
India	0,109	31	0,217	30	0,248	29	0,258	30	0,213	31
Ireland	0,488	14	0,478	14	0,489	16	0,391	25	0,382	17
Israel	0,525	12	0,423	20	0,412	27	0,517	10	0,339	26
Italy	0,464	15	0,491	13	0,492	14	0,518	9	0,501	9
Japan	0,357	21	0,426	19	0,498	13	0,482	15	0,427	16
Latvia	0,274	27	0,336	25	0,490	15	0,500	13	0,360	21
Lithuania	0,323	23	0,371	24	0,468	21	0,481	16	0,353	23
Malaysia	0,367	20	0,416	21	0,482	20	0,474	17	0,445	12
Mexico	0,247	29	0,181	31	0,248	30	0,204	31	0,307	28
Moldova	0,201	30	0,255	28	0,235	31	0,267	29	0,245	29
Poland	0,534	11	0,542	10	0,523	10	0,502	12	0,442	13
Republic of Korea	0,405	18	0,467	16	0,520	11	0,512	11	0,535	6
Romania	0,340	22	0,382	23	0,374	28	0,322	27	0,310	27
Russia	0,408	17	0,512	12	0,485	18	0,290	28	0,228	30
Singapore	0,633	5	0,652	5	0,652	4	0,669	2	0,556	3
Sweden	0,777	1	0,770	1	0,759	1	0,668	3	0,508	8
Switzerland	0,738	2	0,688	4	0,674	3	0,655	4	0,528	7
The Czech Republic	0,561	10	0,528	11	0,578	8	0,411	24	0,428	15
The Netherlands	0,674	4	0,715	3	0,624	6	0,650	5	0,583	2
The Slovak Republic	0,306	25	0,332	26	0,447	22	0,422	23	0,459	11
The UK	0,586	8	0,562	9	0,444	23	0,460	19	0,362	20
The USA	0,605	6	0,606	8	0,589	7	0,496	14	0,439	14
Ukraine	0,307	24	0,396	22	0,414	26	0,434	22	0,358	22

Source: calculated and compiled on the basis of (UNDP, 2024; ILO, 2024; The World Bank, 2024; ITU, 2024; EF EPI, 2024; UNESCO, 2024; Fund for Peace, 2024; OECD, 2024; Coursera, 2024)

** the latest available data is presented*

included in the study sample. It is noteworthy that the countries that consistently maintained a position within the top 10 in terms of ICT talent availability throughout the study period were Singapore, Germany, the Netherlands, Sweden, Switzerland and Finland. Furthermore, in terms of geographical region, Western, Southern and Northern Europe were the clear leaders in the surveyed sample in terms of attracting and retaining the most highly skilled ICT professionals in the sector in 2022 (a position they had maintained over the period 2018-2022), followed by countries in Asia, the United States and the Baltic States. Finally, the Eastern European region exhibited comparatively weaker performance relative to the rest of the sample, although it was notable that the Slovak Republic, Poland, and the Czech Republic demonstrated clear dominance.

As for the leaders and outsiders among the countries in the study sample in terms of the availability of a qualified talent pool for the ICT sector, the following can be noted:

1) The average adult literacy rate was 98% (the exception was India with 76.3%);
2) on average, education expenditures among Western, Southern and Northern European countries amounted to 5.3% of GDP (11.2% of public expenditures), the Baltic States – 4.9% of GDP (14% of public expenditures), the United States and Mexico – 4.8% of GDP (15.5% of public expenditures), Eastern European countries – 4.6% of GDP (11.4% of public expenditures) and Asian countries – 3.8% of GDP (14% of public expenditures);
3) the leaders of the PISA mathematics exam were Asian countries with an average score of 517.4 points; the Baltic States received 489.3 points, Western, Southern and Northern Europe – 485.3, Eastern Europe – 452.8, the United States and Mexico – 430;
4) in terms of the share of the population with advanced ICT skills, Malaysia, Sweden, China, the UK and Finland are the leaders, while in absolute terms, China (132.5 million), Mexico (8.4 million) and the UK (6.2 million) have the largest talent pool for the ICT sector;
5) most highly skilled professionals were employed in the US (75.5 million), India (56.3 million) and Russia (31.9 million), while the highest salaries for IT professionals were offered by the ICT sectors of Germany (8343.7 USD per month), France (7841), the US (7511.2), the Netherlands (7221.6) and Finland (7070.3), which indicates the ability to attract and retain the best ICT talent;
6) the Netherlands (661), Singapore (642), Sweden (618), Finland (615), Germany (613) and Poland (600) were in the "Very High Proficiency" category;
7) Sweden, Switzerland, Finland, Singapore, the United States and Germany have been most successful in attracting and retaining skilled workers, while Ukraine is the penultimate in the comparative ranking, ahead of Moldova.

It is noteworthy that Ukraine occupies the 6th position in the surveyed sample of countries in terms of education spending, with an average of 5.47% of GDP, trailing only Sweden, Israel, Finland, Moldova and Estonia. Furthermore, Ukraine ranks 10th in terms of education spending in the structure of public expenditures, with a proportion of 14%, behind Malaysia, Israel, Moldova, Hong Kong, Mexico, Switzerland, Estonia, India and the United States. This high level of investment reflects the national priority of education, which is important for developing the knowledgeable and skilled workforce needed for the ICT sector in terms of (1) providing a better educational base, resources and opportunities, leading to a more skilled and competent workforce; (2) enhancing competitive advantage in the global ICT market; and (3) fostering innovation, critical thinking and problem-solving skills.

Furthermore, Ukraine was ranked 27th in terms of the proportion of the population with advanced ICT skills, placing it behind both international and regional leaders. Nevertheless, when this indicator is considered in absolute terms, Ukraine (343.1 thousand people with advanced ICT skills) is situated behind Poland (1.645 million people), Russia (1.479 million people), the Czech Republic (529.9 thousand people), and Hungary (396.7 thousand people) in Eastern Europe. Furthermore, in a global context, Ukraine demonstrated a competitive advantage in terms of its ICT talent pool, outperforming countries such as Ireland, Romania, Hong Kong, the Slovak Republic, Lithuania, Estonia, Bulgaria, and Latvia.

It is noteworthy that in 2022, Ukraine (539) was ranked 20th in the surveyed sample in terms of English language proficiency, thus entering the category of countries with "Moderate Proficiency". This placed Ukraine ahead of the Republic of Korea (537), Russia (530), Moldova (528), India (516), China (498), Japan (475), and so forth. Moreover, Ukraine was ranked 15th in the global skills ranking, ahead of countries with advanced technological capabilities, including Singapore, Hong Kong, the Republic of Korea, China, the United Kingdom, and the United States. In particular, in terms of advanced skills, Ukraine's position in the study sample is as follows:

1) 17th place in terms of business skills development (54%), ahead of the US (53%), India (52%), Estonia (49%), the UK (42%), Romania (35%), Hungary (33%), Japan (27%), etc;
2) 3rd place in terms of technological skills (94%), behind Switzerland (99%) and Mexico (97%);
3) 17th place in terms of data skills (67%), ahead of Poland (66%), Italy (64%), Hungary (63%), Romania (53%), the UK (51%), the USA (32%), etc.

Finally, Ukraine has 5.7 million highly skilled workers with an average salary in the ICT sector of 3,250.6 USD per month, making it a very attractive location for software development outsourcing.

3.3. Comparative Assessment of the ICT Regulatory Environment in the World

As illustrated in Table 4, the 2022 global leaders in the study sample, in terms of a favourable business and regulatory environment, were Switzerland, Singapore, Hong Kong, Finland, and the United States. Conversely, Mexico, Moldova, China, Russia, and Ukraine received the lowest scores. By region, the BREI sub-index in 2022 demonstrated that Western, Southern, and Northern Europe exhibited an average score of 0.695, the Baltic States demonstrated a score of 0.691, Asia demonstrated a score of 0.631, the United States and Mexico demonstrated a score of 0.599, and Eastern Europe demonstrated a score of 0.464.

It is worthy of note that, in terms of the arithmetic mean of the principal international indices (World Bank WGI, Corruption Perceptions Index and Index of Economic Freedom), Western, Southern and Northern Europe (80.92) and the Baltic States (75.79) are the leaders in the surveyed sample (Figure 1). This reflects a stable and favourable business environment that stimulates innovation, attracts investments and serves as a solid foundation for the international competitiveness of the ICT sectors in these regions. Moreover, in 2022, Singapore (92.9), Switzerland (90.5), Finland (87.8), Sweden (86.4) and Ireland (85.3) exhibited the highest average scores in the sample, while China (45.3), Moldova (43.6), Mexico (41.1), Ukraine (33.3) and Russia (27.9) demonstrated the lowest. Ultimately, the findings

Table 4
Business and Regulatory Environment Sub-Index Results in 2018-2022*

Country	2018		2019		2020		2021		2022	
	BREI	Rank	BREI	Rank	BREI	Rank	BREI	Rank	BREI	Rank
Bulgaria	0,524	22	0,526	22	0,441	24	0,437	24	0,468	24
China	0,373	27	0,381	26	0,376	28	0,377	28	0,375	29
Estonia	0,679	11	0,67	10	0,708	8	0,705	8	0,73	6
Finland	0,747	6	0,746	6	0,756	5	0,758	5	0,766	4
France	0,533	21	0,536	20	0,56	17	0,563	17	0,599	17
Germany	0,657	12	0,641	13	0,664	13	0,651	14	0,677	12
Hong Kong	0,874	1	0,827	3	0,811	3	0,786	3	0,788	3
Hungary	0,554	20	0,545	18	0,526	20	0,523	21	0,565	19
India	0,342	28	0,362	27	0,422	26	0,419	26	0,460	25
Ireland	0,764	5	0,75	5	0,715	7	0,712	7	0,723	7
Israel	0,566	16	0,566	16	0,591	16	0,561	18	0,557	21
Italy	0,521	23	0,514	23	0,524	21	0,533	20	0,559	20
Japan	0,693	10	0,667	11	0,674	12	0,664	12	0,676	13
Latvia	0,562	17	0,547	17	0,551	18	0,568	16	0,627	15
Lithuania	0,644	13	0,664	12	0,677	11	0,674	11	0,717	8
Malaysia	0,616	15	0,608	15	0,617	15	0,613	15	0,612	16
Mexico	0,395	26	0,36	28	0,407	27	0,395	27	0,441	27
Moldova	0,34	29	0,348	29	0,36	29	0,375	29	0,418	28
Poland	0,561	18	0,544	19	0,512	22	0,502	22	0,534	22
Romania	0,436	25	0,427	25	0,425	25	0,433	25	0,457	26
Russia	0,318	30	0,304	30	0,319	30	0,308	30	0,337	30
Singapore	0,848	3	0,843	2	0,849	1	0,847	1	0,836	2
Sweden	0,699	8	0,688	8	0,702	9	0,705	9	0,700	10
Switzerland	0,856	2	0,844	1	0,832	2	0,826	2	0,839	1
The Czech Republic	0,557	19	0,535	21	0,535	19	0,537	19	0,573	18
The Netherlands	0,697	9	0,683	9	0,687	10	0,685	10	0,678	11
The Republic of Korea	0,625	14	0,615	14	0,653	14	0,657	13	0,672	14
The Slovak Republic	0,502	24	0,492	24	0,491	23	0,489	23	0,513	23
The UK	0,739	7	0,735	7	0,732	6	0,725	6	0,711	9
The USA	0,798	4	0,774	4	0,758	4	0,764	4	0,757	5
Ukraine	0,304	31	0,292	31	0,243	31	0,237	31	0,313	31

Source: calculated and compiled on the basis of (The World Bank, 2024; The Heritage Foundation, 2024; Property Rights Alliance, 2024; ITU, 2024; Transparency International, 2024; Trading Economics, 2024)

** the latest available data is presented*

of the International Property Rights Index indicate that in 2022, the legal systems of Finland, Singapore, Switzerland, the Netherlands, and Japan were identified as the most effective in protecting property rights. Conversely, Bulgaria, Mexico, Russia, Moldova, and Ukraine exhibited comparatively weaker performances within the sample.

Furthermore, in 2022, the United States and Mexico exhibited a stable comparative advantage in terms of the tax burden (Table 5) on the ICT business (with the exception of the average corporate income tax rate) in comparison to other regions. This indicates a balance between competitive tax rates and effective social security systems, which is crucial for the creation of a favourable business environment for the ICT sector.

Finally, with regard to the tax burden on IT businesses in Ukraine compared to the sample of countries studied, the following should be noted:

1) The corporate tax rate (18%) was one of the lowest, second only to Singapore, Hong Kong, Romania, Lithuania, Switzerland, Ireland, Moldova, Bulgaria and Hungary;

2) the sales tax rate (20%) – only in Germany, Romania, India, Israel, Mexico, China, the Republic of Korea, Malaysia, Japan, Switzerland, Singapore and the United States of America;

3) the rate of the unified social tax (22%) is second only to Finland, Bulgaria, Singapore, Japan, the United Kingdom, Malaysia, Hungary, India, Ireland, the United States, Israel, Mexico, Switzerland, Romania and Lithuania.

It is worth noting that in 2022 (Table 6), the vast majority of countries in the survey sample (25 out of 31 countries) had a fairly comprehensive ICT regulatory system, including regulatory authorities and their powers, relevant legal provisions, and competition policy in the ICT sector. Regionally, Western, Southern and Northern Europe are the relative leaders with an average score of 94.72 out of 100, followed by the Baltic States (92.33), the Americas (92.25), Eastern Europe (85.94) and Asia (79.39).

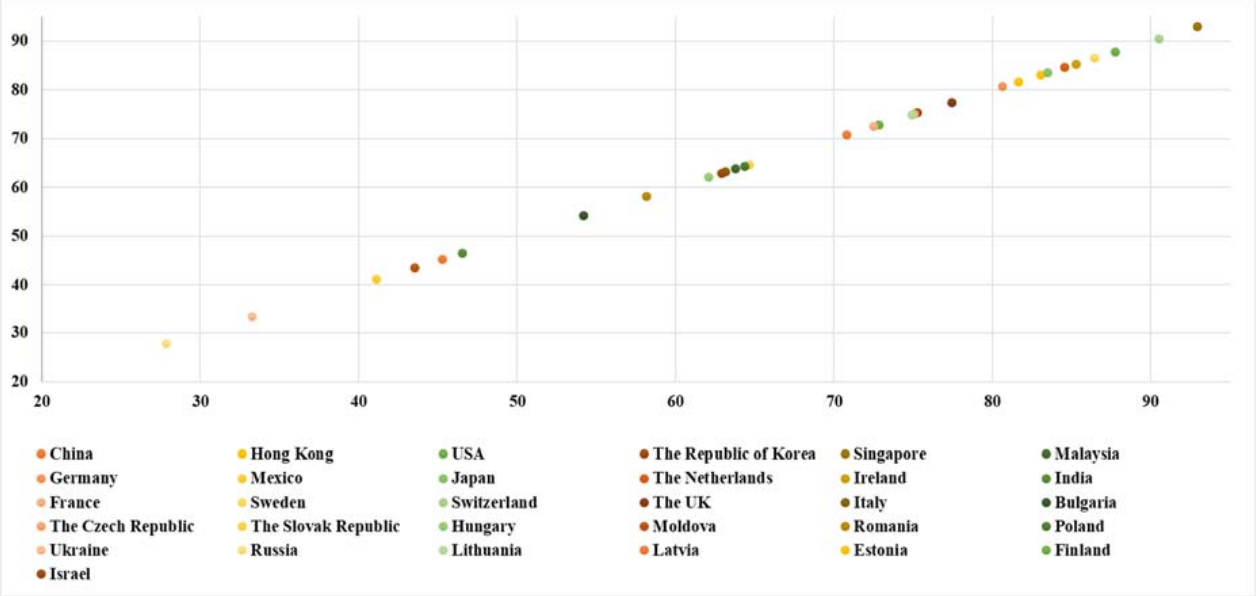

Figure 1. General assessment of the political and business environment

Source: calculated and compiled on the basis of (The World Bank, 2024; The Heritage Foundation, 2024; Transparency International, 2024)

** the latest available data is presented*

Table 5

Average rates of the main types of taxes by region in 2022*

Region / Tax rate	Asia	Western, Southern and Northern Europe	Baltic States	Eastern Europe	USA and Mexico
Corporate tax rate	25.08	21.29	18.33	16	25.5
Sales tax rate	11.33	20.19	20.67	21.11	8
Social security rate for companies	17.28	22.78	19.72	22.45	7.62
Social security rate for employees	12.98	13.29	11.2	12.88	4.65

Source: calculated and compiled on the basis of (Trading Economics, 2024)

** the latest available data is presented*

Table 6
Grouping countries by generation of ICT regulatory model in 2022*

Generation	Value range	Characteristics	Countries
G2	≥ 40	Partial liberalisation and privatisation	China, Russia
G3	≥ 70	Promoting investment, innovation and access, double focus on competition, consumer protection	Ukraine, Japan, Israel, the Republic of Korea
G4	≥ 85 ≤ 100	Comprehensive regulation, taking into account the goals of economic and social policy	Italy, Lithuania, Ireland, Finland, France, the United Kingdom, Mexico, Bulgaria, Hungary, Singapore, Germany, the Netherlands, Switzerland, Romania, the USA, Estonia, Moldova, Slovakia, Poland, Sweden, the Czech Republic, Latvia, Hong Kong, Malaysia, India

Source: compiled on the basis of (ITU, 2024)

** the latest available data is presented*

In the study sample, Ukraine exhibited the highest ICT Regulatory Tracker score, ranking ahead of only Japan, Israel, the Republic of Korea, China, and Russia. Furthermore, over the period 2007-2022, Ukraine made incremental progress in the implementation of regulatory practices within the ICT sector, advancing from the G2 generation (44.8 points) to the G3 generation (78 points).

In addition, most of the surveyed countries are making significant efforts to develop and modernise their cybersecurity systems at the national, regional and global levels. In particular, the leaders of the Global Cybersecurity Index are the United States (100), the United Kingdom (99.54), Estonia (99.48), the Republic of Korea (98.52), and Singapore (98.52). Taking into account all the risks and difficulties faced by Ukraine as a result of Russia's armed aggression, Ukraine (65.93) ranked last in the sample of countries surveyed, which indicates insufficient capacity to counter cyber threats and the need for priority efforts to strengthen its cyber resilience.

3.4. Comparative Assessment of the ICT Innovation Potential of Countries

According to the calculations (Table 7), in 2022, the greatest innovation potential in the ICT sector was available in China, Hong Kong, Russia, the United States, Germany, and the Republic of Korea, while the potential was relatively weaker in Slovakia, Bulgaria, and the Baltic States. Regionally, the most innovative region according to the RDI is Asia, followed by the United States and Mexico, Eastern Europe, Western, Southern and Northern Europe, and the Baltic States. It should be noted that the final results of the 2022 index do not fully reflect the state of research and innovation potential in some countries due to a lack of statistical data for calculations.

As for the leaders and outsiders among the countries in the study sample in terms of the innovation potential of the ICT sector, the following can be noted:

1) The Republic of Korea (8483.2), Sweden (7755.3), Finland (7384.6), Singapore (7095.7) and Switzerland (5792.8) are the leaders in terms of the ratio of the number of scientists to 1 million people, while Romania (922.2), Moldova (810.2), Ukraine (809.7), Mexico (348.7) and India (255.7) are the outsiders;
2) researchers in the surveyed countries published 541 thousand scientific papers on various aspects of ICT: 55.5% of all published papers were from Asia, 21.5% from Western, Southern and Northern Europe, 14.7% from the USA and Mexico, and 7.2% from Eastern Europe;
3) in terms of the number of registered patents in various ICT categories, the leaders are China – 796 thousand patents, the United States – 686 thousand patents, Japan – 201 thousand patents and the Republic of Korea – 180 thousand patents, with Asian countries being the most active in registering scientific achievements (62% of patents issued in the survey sample) and American countries – 35.6%;
4) countries in Western, Southern and Northern Europe spent the most on R&D – 2.5% of annual GDP, Asia – 2.1%, the Baltic States – 1.1% and Eastern Europe – 0.96% (the leaders were Israel (5.31% of annual GDP), the Republic of Korea (4.72%) and Sweden (3.4%));
5) the leading exporters of high technologies were China (769.7 billion USD), Germany (223.4 billion USD), Hong Kong (194.1 billion USD), the United States (166.4 billion USD) and the Republic of Korea (98.5 billion USD).

It is worth noting that in 2018-2022, Ukraine was the only country in the survey sample to experience a steady decline in the ratio of the number of scientists to 1 million people – from 988.1 to 580.8 scientists per 1 million people. Despite a gradual increase in the number of scientific papers in the ICT sector in Ukraine during 2018-2021, due to Russia's full-scale war in Ukraine, forced relocation and suspension of research activities of specialists and scientists, there was a 25% drop in 2022 compared to 2021. As of 2022,

Table 7
R&D Potential Sub-Index Results in 2018-2022*

Country	2018		2019		2020		2021		2022	
	RDI	Rank	RDI	Rank	RDI	Rank	RDI	Rank	RDI	Rank
Bulgaria	0,078	25	0,077	25	0,076	24	0,068	24	0,002	28
China	0,680	1	0,680	1	0,711	1	0,713	1	0,600	1
Estonia	0,144	18	0,143	19	0,143	17	0,143	17	0,001	30
Finland	0,291	7	0,283	8	0,279	8	0,282	7	0,005	26
France	0,270	10	0,254	11	0,237	10	0,228	10	0,044	10
Germany	0,363	5	0,347	5	0,319	5	0,310	5	0,090	5
Hong Kong	0,223	12	0,223	13	0,223	11	0,223	11	0,458	2
Hungary	0,157	16	0,149	17	0,154	16	0,153	15	0,008	23
India	0,114	22	0,105	23	0,091	23	0,074	23	0,080	8
Ireland	0,171	15	0,167	16	0,161	14	0,159	14	0,023	18
Israel	0,209	13	0,208	14	0,208	12	0,208	12	0,008	24
Italy	0,149	17	0,144	18	0,141	18	0,134	18	0,035	12
Japan	0,399	4	0,362	4	0,342	4	0,323	4	0,080	7
Latvia	0,058	26	0,056	26	0,064	26	0,067	25	0,001	31
Lithuania	0,106	23	0,107	22	0,114	21	0,116	20	0,002	29
Malaysia	0,124	21	0,037	27	0,071	25	0,033	27	0,027	15
Mexico	0,032	29	0,029	29	0,029	28	0,023	29	0,036	11
Moldova	0,017	31	0,012	31	0,012	31	0,009	31	0,009	22
Poland	0,134	19	0,130	20	0,131	19	0,134	19	0,016	19
Romania	0,034	28	0,030	28	0,032	27	0,029	28	0,006	25
Russia	0,129	20	0,122	21	0,121	20	0,106	21	0,285	3
Singapore	0,291	8	0,290	7	0,287	7	0,047	26	0,031	14
Sweden	0,337	6	0,324	6	0,311	6	0,309	6	0,012	21
Switzerland	0,017	30	0,266	10	0,016	30	0,263	8	0,027	17
The Czech Republic	0,184	14	0,176	15	0,174	13	0,176	13	0,015	20
The Netherlands	0,257	11	0,246	12	0,244	9	0,240	9	0,033	13
The Republic of Korea	0,512	3	0,487	3	0,485	3	0,485	2	0,081	6
The Slovak Republic	0,102	24	0,097	24	0,098	22	0,094	22	0,004	27
The UK	0,286	9	0,267	9	0,154	15	0,150	16	0,049	9
The USA	0,611	2	0,583	2	0,573	2	0,397	3	0,245	4
Ukraine	0,035	27	0,028	30	0,027	29	0,020	30	0,027	16

Source: calculated and compiled on the basis of (UNESCO, 2024; WIPO, 2024; The World Bank, 2024; Scimago, 2024)

** the latest available data is presented*

Ukraine has lost ground to most of the countries surveyed in terms of high-tech exports, which decreased by 27% compared to 2018 (from 1.2 billion USD to 888 million USD). Finally, during 2018-2022, Ukraine ranked 19th in the study sample in terms of the number of issued patents in the ICT sector – 177 patents, ahead of Bulgaria (97), the Czech Republic (90), Romania (70), Lithuania (58), Slovakia (48), etc. However, during the period under review, Ukraine saw a 97% decrease in the number of registered patents (from 123 to 4 patents).

3.5. Comparative Assessment of the Global Presence of the ICT Sector in the World

The participation of the ICT sector in international cooperation and trade is important for enhancing its international competitiveness by providing access to global markets, promoting innovation and knowledge sharing, realising economies of scale, providing access to talent and resources, etc. According to the calculations (Table 8), in 2022, the leaders in the ITII index were Ireland, the Republic of Korea, Latvia, Lithuania, and Slovakia, while Russia, the United States, China, and Singapore were relative outsiders. It is worth noting that during the research period, all countries in the sample were WTO members, and the majority (21 countries) were OECD members, which contributes to a favourable environment for the growth and competitiveness of the ICT sector in these countries in the international arena.

It should be emphasised that the largest sellers in the global ICT market in 2018-2022 were China (3.5 trillion USD), Hong Kong (1.7 trillion USD), the Republic of Korea (804 billion USD), the United States (734 billion USD) and Singapore (680 billion USD);

Table 8
ICT Sector Involvement Sub-Index Results in 2018-2022*

Country	2018		2019		2020		2021		2022	
	ITII	Rank	ITII	Rank	ITII	Rank	ITII	Rank	ITII	Rank
Bulgaria	0,500	23	0,500	24	0,500	24	0,500	24	0,500	24
China	0,477	29	0,466	29	0,437	30	0,429	30	0,449	30
Estonia	0,666	6	0,666	5	0,658	11	0,659	8	0,664	6
Finland	0,661	9	0,662	8	0,659	10	0,659	7	0,659	9
France	0,594	18	0,591	18	0,575	19	0,574	18	0,583	17
Germany	0,532	21	0,523	21	0,521	20	0,518	20	0,526	18
Hong Kong	0,458	31	0,462	30	0,466	29	0,467	29	0,491	27
Hungary	0,663	8	0,661	9	0,660	7	0,660	5	0,662	7
India	0,545	20	0,531	20	0,519	21	0,507	21	0,514	20
Ireland	0,806	1	0,806	1	0,795	1	0,797	1	0,796	1
Israel	0,682	2	0,681	2	0,678	2	0,519	19	0,523	19
Italy	0,630	15	0,628	15	0,624	15	0,626	14	0,625	13
Japan	0,590	19	0,575	19	0,576	18	0,576	17	0,597	16
Latvia	0,666	4	0,666	3	0,666	3	0,666	2	0,666	3
Lithuania	0,666	5	0,666	4	0,666	4	0,666	3	0,665	4
Malaysia	0,493	26	0,493	27	0,491	26	0,491	26	0,500	22
Mexico	0,658	11	0,656	12	0,659	8	0,658	9	0,499	25
Moldova	0,500	24	0,500	23	0,500	23	0,500	23	0,500	23
Poland	0,657	12	0,656	11	0,651	12	0,649	11	0,650	10
Romania	0,497	25	0,496	25	0,494	25	0,493	25	0,494	26
Russia	0,479	28	0,480	28	0,476	28	0,477	27	0,488	28
Singapore	0,461	30	0,450	31	0,428	31	0,425	31	0,438	31
Sweden	0,650	13	0,648	13	0,640	13	0,637	12	0,636	12
Switzerland	0,623	17	0,620	16	0,616	16	0,618	15	0,623	14
The Czech Republic	0,660	10	0,660	10	0,659	9	0,658	10	0,660	8
The Netherlands	0,624	16	0,615	17	0,613	17	0,611	16	0,615	15
The Republic of Korea	0,672	3	0,664	6	0,660	6	0,660	6	0,669	2
The Slovak Republic	0,664	7	0,663	7	0,663	5	0,663	4	0,665	5
The UK	0,645	14	0,641	14	0,632	14	0,632	13	0,639	11
The USA	0,489	27	0,493	26	0,480	27	0,472	28	0,487	29
Ukraine	0,502	22	0,502	22	0,502	22	0,502	22	0,503	21

Source: calculated and compiled on the basis of (UNCTADstat, 2024)

** the latest available data is presented*

in addition, in the regional context, Asian countries accounted for 74% of global ICT exports. In addition, China (837.4 billion USD), the Republic of Korea (366.9 billion USD), Malaysia (159.4 billion USD) and Singapore (103.4 billion USD) had the largest trade surpluses, while Japan (154.7 billion USD), the UK (164.6 billion USD), Germany (164.6 billion USD), India (201.6 billion USD) and the US (1.06 trillion USD) had trade deficits in ICT goods. In addition, in terms of exports of ICT goods in 2018-2022, Ukraine (2.09 billion USD) was ahead of only Moldova (0.035 billion USD) with a trade deficit of 14.8 billion USD.

During 2018-2022, the largest suppliers of ICT services in the study's sample were Ireland (812 billion USD), India (373 billion USD), China (320 billion USD), the United States (286 billion USD) and the United Kingdom (189 billion USD), with Western, Southern and Northern Europe accounting for 54.8% of the sample's ICT services exports, Asia 28.9%, the United States and Mexico 9.1%, Eastern Europe 6.7% and the Baltic States 0.6%. In addition, Ireland (672.8 billion USD), India (316.3 billion USD), the United Kingdom (186.4 billion USD) and the United States (177.7 billion USD) had the largest trade surpluses, while Latvia (20.3 billion USD), Moldova (29.3 billion USD), Mexico (109.6 billion USD) and Singapore (136 billion USD) had trade deficits in ICT services. Finally, in terms of exports of ICT services in 2018-2022, Ukraine (27.6 billion USD) was ahead of such countries as the Czech Republic, Hong Kong, Malaysia, Hungary, Bulgaria and others included in the study's sample, with a positive trade balance of 24.8 billion USD.

3.6. Comparative Assessment of ICT Competitiveness in the World

According to the calculations (Table 9), in 2022, Hong Kong, Finland, Singapore, the Republic of Korea, Switzerland, and Germany were the world leaders in ICT, while Romania, Bulgaria, Moldova, Mexico, India, and Ukraine were relative outsiders. In addition, the ICT sectors of the United States, the Republic of Korea, Singapore, the Netherlands, Sweden, Switzerland and Finland proved to be the most stable in maintaining their competitive advantage internationally, as they did not leave the top 10 in the sample of countries studied. Finally, countries such as Germany, Italy, Moldova, Lithuania and Latvia demonstrated a strengthening of their own ICT competitive advantage as they consistently improved their positions in the benchmark rankings over the period 2018-2022.

Regarding the share of the structural components of the calculated index in the overall assessment of the international competitiveness of the ICT sector in 2022, it can be noted that the business and regulatory environment, participation of the ICT sector in international activities, and ICT infrastructure have a predominant influence on the formation of competitive advantages and maintenance of the international competitiveness of the ICT sectors of the studied sample of countries.

In particular, in the Asian region, the indicators of the business and regulatory environment (27.4% of the total score), integration of the ICT sector into international economic relations (23.4%), and ICT infrastructure (22.9%) had the greatest impact on the overall score (on average across the sample of countries for the study). For example, in Western, Southern and Northern Europe, the largest

Table 9
ICT Sector International Competitiveness Index Results in 2018-2022*

Country	2018		2019		2020		2021		2022	
	ITSIC	Rank	ITSIC	Rank	ITSIC	Rank	ITSIC	Rank	ITSIC	Rank
Bulgaria	35,6	26	36	27	37,2	26	37,7	25	36,6	27
China	47,1	18	48,2	18	50,8	14	49,6	16	46	15
Estonia	48,5	17	50,5	14	53,3	9	53,3	7	48,3	10
Finland	60,2	2	61,4	2	60,4	1	60,6	1	52,5	2
France	50,3	13	51,9	13	48,2	18	50,2	14	46,4	13
Germany	52,8	11	54,6	9	53,9	7	54,2	6	49,7	6
Hong Kong	52,9	10	53	11	53,6	8	52	10	58,1	1
Hungary	46,4	20	46,2	21	46,8	20	46	21	41,4	23
India	28,4	30	32	28	30,8	29	31,3	28	31	30
Ireland	54,9	9	54,4	10	52,8	12	49,6	15	46,1	14
Israel	50,2	14	49,1	16	49,3	17	47,8	18	37,4	24
Italy	46,4	21	46,8	20	46,3	22	47,1	19	45,5	16
Japan	52,2	12	52,9	12	52,9	11	50,3	13	45,1	18
Latvia	40,4	24	43,8	22	46,6	21	46,9	20	44,7	19
Lithuania	46,5	19	48,2	17	50,2	15	51,3	11	47,7	11
Malaysia	40,7	23	40,3	24	42,5	24	41,3	24	41,6	22
Mexico	33,4	28	31	30	32,3	28	30,2	30	31,2	29
Moldova	27,3	31	28,8	31	29,8	30	30,9	29	32,2	28
Poland	49,1	16	49,5	15	47,7	19	48,1	17	45,1	17
Romania	36,2	25	37,3	26	36,9	27	36,7	26	36,6	26
Russia	35,1	27	38,5	25	37,9	25	34	27	36,9	25
Singapore	57,3	4	58,3	5	57,1	5	53,1	8	50,8	3
Sweden	59,8	3	61,1	3	60	2	58,2	4	49,1	7
Switzerland	55,8	7	59,8	4	53,3	10	58,4	2	50,6	5
The Czech Republic	49,9	15	47,9	19	49,7	16	45,5	22	44,2	20
The Netherlands	56,7	5	57,8	6	54,7	6	54,7	5	48,9	8
The Republic of Korea	56,1	6	57,5	7	58,3	4	58,4	3	50,8	4
The Slovak Republic	41	22	42,1	23	44,4	23	43,4	23	41,8	21
The UK	55,7	8	55,4	8	51,1	13	50,8	12	46,6	12
The USA	62,8	1	62,7	1	59,4	3	52,9	9	48,6	9
Ukraine	29,8	29	31,2	29	29,8	31	28,9	31	27,6	31

Source: calculated by the authors on the basis of Tables 2-4 and Tables 7-8

** the latest available data is presented*

contributors were the business and regulatory environment (28.7% of the total score), the integration of the ICT sector into international economic relations (26.3%) and ICT infrastructure (22.7%). In the Baltic States, the largest building blocks were the business and regulatory environment (29.4% of the total score), the integration of the ICT sector into international economic relations (28.4%) and ICT infrastructure (26.6%). In Eastern Europe, the largest share of the ICT sector's international competitiveness index was accounted for by the integration of the ICT sector into international economic relations (30.1% of the total score), ICT infrastructure (24.6%) and the business and regulatory environment (24.3%). In the United States and Mexico, the structure of the overall index was influenced by the business and regulatory environment (29.7% of the total score), integration of the ICT sector into international economic relations (26%) and ICT infrastructure (19.2%).

In addition, human capital was the fourth most important factor affecting the international competitiveness of the ICT sector in all regions surveyed: in Western, Southern and Northern Europe – 20.8% of the total score, the United States and Mexico – 18.9%, Eastern Europe – 18.7%, Asia – 18.3%, and the Baltic States – 15.5%.

With regard to the comparative advantages of Ukraine's ICT sector among the countries in the study sample, the results of the ITSIC composite index indicate a relatively lower ability to compete with global and regional technology leaders. In particular, in the overall ranking, Ukraine's ICT sector was ranked 29th among 31 countries in 2018-2019, but after the COVID-19 pandemic and Russia's full-scale war in Ukraine, its position in the surveyed sample of countries deteriorated to the last 31st place. However, in terms of individual structural elements in 2018-2022, Ukraine achieved the following results: (1) in terms of the ICTI sub-index (average value 5.7), it was ahead of Mexico, India and Moldova; (2) in terms of the HCI sub-index (average value 7. 6), it was ahead of the Slovak Republic, China, Latvia, Bulgaria, Mexico, Moldova, India, Romania, Lithuania, Israel, the Czech Republic, Ireland, Russia and Hungary; (3) according to the BREI sub-index (average value 5.6), it had a constant competitive disadvantage, which indicates an extremely unfavourable regulatory and business environment for the ICT sector; (4) in terms of the RDI sub-index (average value 0.5), it is ahead of Romania, Mexico, Switzerland, Moldova, Ireland, Poland, Czech Republic, Sweden, Moldova, Hungary, Israel, Finland, Slovak Republic, Bulgaria, Lithuania, Estonia and Latvia; (5) in terms of the ITII sub-index (average value of 10), it is ahead of Bulgaria, Moldova, Romania, Malaysia, the USA, Russia, China, Singapore and Hong Kong. Finally, the degree of involvement of Ukraine's ICT sector in international trade in IT goods and services and international cooperation (34% of the total score), the availability of skilled human resources (26%), and the developed ICT infrastructure (19%) had a significant impact on the consolidated assessment of the international competitiveness of Ukraine's ICT sector.

4. Conclusions

A comparative analysis of the factors influencing international competitiveness in the ICT sectors of 31 countries revealed that Western, Southern, and Northern Europe consistently demonstrated a competitive advantage in the global information and communication technologies market during the 2018-2022 period. In contrast, Eastern Europe exhibited comparatively weaker performance within the study sample. It is noteworthy that in all the regions surveyed, the international competitiveness of the ICT sector was most strongly influenced by three key factors: the stability and favourable business environment, the ICT sector's involvement in international activities (including trade and cooperation), and ICT infrastructure. The fourth most significant factor influencing the international competitiveness of the ICT sector in the surveyed countries was human capital, encompassing its quantity, qualifications, and cost. The factor of R&D activity was found to be the least influential. However, it should be noted that the final results of the index do not fully reflect the state of R&D in some countries due to a lack of statistical data for calculations.

The comparative analysis of Ukraine's ICT sector in the global market, as represented by the composite index, reveals that when benchmarking the sector's international competitiveness with global and regional technological leaders, the domestic ICT sector is found to be significantly inferior in the majority of indicators across all structural elements of the composite index. The main problems that hinder the development and reduce the competitive position of Ukraine's ICT sector cover a wide range of impacts on individual components of competitiveness, namely: risks of improper functioning of the digital infrastructure due to physical damage and destruction, power outages, cyberattacks and cyberwarfare, and so forth; gradual migration of specialists, scientists, businesses, investors, etc. abroad, which reduces the prospects for at least stable functioning of the industry as a whole; low domestic demand and consumption of IT goods and services; unclear mechanism of recruitment and mobilisation of IT specialists; deterioration of the international reputation of domestic IT companies and specialists due to instability and uncertainty of the

business environment in Ukraine; reduction in the number of orders and projects with foreign contractors; decline in domestic demand in the IT labour market, which makes it impossible to employ young specialists without significant market expertise; lack of a proper consolidated approach between the state, business and education in matters related to training and retraining of human resources, industry regulation, protection of property rights, intellectual property rights, investment attraction, etc.

Ultimately, in order to enhance the competitive standing of the domestic ICT sector, Ukraine must devise a revised strategy for the digitalisation and advancement of the ICT sector. This strategy must encompass structural and systemic measures designed to transform and optimise the utilisation of pivotal factors influencing its global competitiveness.

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