УДК [339:330.341.1](4):004.77 DOI: http://dx.doi.org/10.30970/meu.2022.47.0.4705
JEL: L16; L86; O57; P27

THE ROLE OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES IN THE STRUCTURAL CHANGES OF EUROPEAN COUNTRIES WITH TRANSFORMATION ECONOMIES

Svitlana Urba[1], Ihor Nazarkevych[2], Bohdan Vasylkiv[3], Liliya Palashchyn[4]

Ivan Franko National University of Lviv,
179008 Lviv, Prospekt Svobody, 18
[1]e-mail: svitlana.urba@lnu.edu.ua
ORCID ID: https://orcid.org/0000-0003-1778-8845
[2] e-mail: nazigor22@gmail.com
ORCID ID: https://orcid.org/0000-0001-5856-531X
[3] e-mail: vasylkivb.l.777@gmail.com
ORCID ID: https://orcid.org/0000-0003-4469-8239
[4] e-mail: liliya.palaschyn@lnu.edu.ua

Abstract. *The research aims to describe the functional relationship between the development of the ICT industry and structural changes in European transitional economies. The role of the ICT industry as an export accelerator for European transitional economies and its impact on the development of global markets is substantiated. Based on the process approach to decision management in the ICT industry, the definition of IT customization is offered. The peculiarities and dynamics of the ICT industry development in the transitional economies of Central European countries are analyzed, and the main factors influencing the state of the industry are outlined. Modern tools for stimulating the development of the ICT industry are considered. The ICT sector has a transformative ability to make significant structural changes in the national economy, impacting the organization and structure of the labor market and financial instruments and operations, as well as widening access to resources and markets. It stimulates the development of civil society institutions, increasing the management efficiency.*
Keywords: *ICT-sector, transitional economy, structural changes, IT-customization, innovations.*

Problem statement. The paradigm of a modern national economy based on a model of sustainable development cannot be abstracted from information and communications technology (ICT). ICT is not just an industry in which a competition between similar entities for the creation of software products and their realization takes place. It is also a digital solutions system that allows identifying competitive advantages in other areas and industries of the national economy.

Analysis of latest research works and publications. According to Sidenko V.R., the dynamics of international trade in goods that include modern ICT provides convincing evidence that exactly this group of goods is a leading one in the entire category of high-tech products (stemming from the ICT role in the progress of the fifth technological mode) [13].

Nepelski D., De Prato G. emphasize that digitalization has changed the way information and knowledge are handled and manipulated as they are stored in digital rather than physical format. At the aggregated level, this implies a transformation of the economic structures that rely on information and knowledge to produce goods and services. The extensive use of digital information by the ICT sector allows it to overcome the limitations of distance [10, p. 960].

Most development strategies of European countries with transitional economies consider the ICT sector as a driver of growth and structural modernization of the national economy. The ICT sector is characterized by high labor remuneration, productivity, and added value, which allows the attraction of the best professionals from other less productive industries. However, the diffusion of knowledge and digital technologies produced by the ICT sector for other areas contributes to increasing the capacity and competitiveness of the entire national economy.

Statement of objectives. The research aims to disclose the functional interrelation between the development of the ICT industry and structural changes in the European transitional economies (ETE).

Research methods. A methodological framework for research includes the principles of macroeconomics and ideas and concepts of domestic and foreign scientists on the role of the ICT industry in ensuring qualitative structural transformation in the national economy.

The research is based on a systematic approach that stipulates the use of analysis, synthesis, classification, and systematization methods. It allows identifying the components, status, and trends of the ICT industry development and its impact on structural transformations in Central and Eastern European countries with transitional economies. Using economic and statistical methods, the research presents data that illustrate the dynamics of the main ICT industry development parameters and identify their major trends and patterns to substantiate the recommendations regarding the necessary management measures in conditions of structural transformations.

The research database contains statistical materials from World Bank, Eurostat, ITU, and Eurofound, as well as analytical reports from CompTIA, International Data Corporation, and United Nations Capital Development Fund.

Presentation of principal material of the research. The share of ICT in global GDP and in the global labor market is growing rapidly every year. Moreover, it is essential to emphasize the pervasive ability of this industry in almost all spheres of economic relations and social human activities. IT technologies not only make the life of a person or an organization more comfortable and eventful, but they also create new activities, facilitate the access to information and thus the necessary knowledge, and even promote the de-monopolization in the markets. However, the pace of economic development is increasing, being of a non-linear nature, which complicates the accuracy of forecasting the condition of the economic system even in the nearest future. Ten years ago, the cryptocurrency market as such did not exist, but today cryptocurrencies increasingly change the financial market system. And no one can say what the financial markets will look like and what the key financial instruments will be in the next 10 years.

The dynamic ICT industry development is accompanied by its expansion and complication (Figure 1), which needs attention and necessary regulatory support at the highest global and national levels.

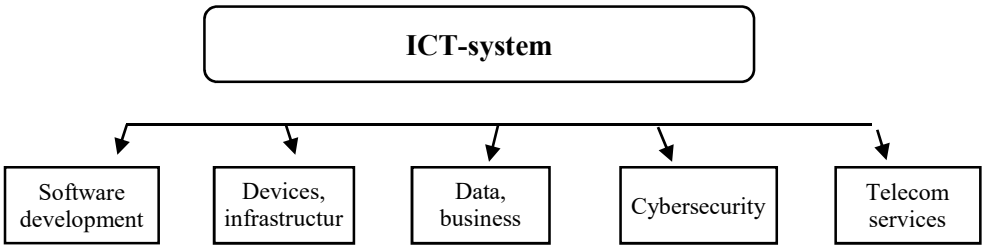

Figure 1. The component structure of the ICT industry*

**Source: compiled by the authors*

Innovation accelerators are the main drivers of the ICT industry: the Internet of Things (IoT), robots, augmented (AR) and virtual (VR) reality, 3D printers, cognitive computing, artificial intelligence, and the next generation of information security technologies (IS).

According to Gartner analytical company, the total volume of the global ICT market increased by 9% in 2021 compared to 2020 and amounted to $ 4.24 trillion[21]. The experts attribute the slight growth in the ICT industry to the COVID-19 pandemic that has caused the decline in corporate budgets for equipment, software, and services. Meanwhile, the large-scale spread of the coronavirus infection has fostered digitalization that has generated a significant demand for cloud and other IT tools.

The largest expenditures on the market accounted for communication services – $ 1.44 trillion, although the segment increased by 3.4% compared to 2020. The sales of corporate software had the highest growth paces. In 2021, they increased by 14.4% and amounted to $ 604.95 billion.

According to the analytical data of Forrester Research on the situation on the ICT market, by late 2021, 60% of the companies had started using containers on public cloud platforms, and 25% of developers had launched serverless functions. The preliminary estimates show that in 2021, the global public cloud infrastructure increased by 35% and amounted to $ 120 billion, and Alibaba Cloud was ranked third in the global rating after Amazon Web Services and Microsoft Azure [16].

The Synergy Research Group analysts have published data that indicate that the total income from the sales of technologies to companies and ICT services providers for businesses of the 13 largest providers in 2021 was $ 613 billion, which is 10% more than the previous year [22]. The largest volume from the sales of ICT solutions for corporate and telecommunication clients in 2021 accounted for Microsoft – $ 120 billion, which is 24% more than the previous year. Such companies as IBM, Amazon, Huawei, and Cisco were next in the rankings. Amazon Web Services with 36% rate and Salesforce and Microsoft with over 20% income growth had the largest annual income growth.

According to V. Kravchenko, the transformation economy is a modern stage of the world economic system development characterized by globalization and urbanization, accelerated paces of scientific and technological progress, informatization processes, transformation of ecology into the economic resource, re-evaluation of old traditional resources and production technologies, and changing state functions [10].

The countries of the former post-socialist camp, such as Poland, Hungary, Ukraine, Romania, Bulgaria, Serbia, and others, can be attributed to the European developing countries and economies that can be considered as transitional because they are in the active phase of the shift from the industrial to the post-industrial society.

This research will address the peculiarities of the IT industry development in three European countries with transitional economies, namely Poland, Romania, and Ukraine, since these countries are in the phase of active structural reform of the national economy, where an important place is given to the ICT industry.

Poland. In 2020, the number of enterprises with 10 or more people employed in the ICT industry amounted to 2,468. 90.8% of them offered ICT services. More than three- quarters of ICT service enterprises provided IT services. The number of persons employed in the ICT sector amounted to 269,000, with eight of ten persons in ICT services. IT services were also the field of activity where enterprises hired the biggest number of persons of all employed in ICT services (75.1%). The value of net revenues from sales in the ICT industry amounted to PLN 189.1 billion in 2020 and increased over a year by 11%. Services, in particular IT services, had the biggest contribution to generating revenues for the ICT industry. Their share in revenues of the whole ICT industry constituted 80.8%. In 2020, ICT manufacturing enterprises earned almost two-thirds of their revenue from export sales, while ICT service enterprises – a quarter. 2020 marked an annual increase in expenditures on research and development in the ICT industry (by 26.2%). The share of R&D expenditures of enterprises providing ICT services in the R&D expenditure of the service sector decreased by 4.1 p. p. Enterprises in the ICT industry were more innovative than enterprises in the entire economy. In 2018–2020, slightly over half of the ICT industry entities introduced innovations in their companies, while the total number of enterprises rate amounted to 31.1%. The value of export and import of ICT products increased in 2020 compared to the previous year (by 15.5% and 18.3%, respectively) [7, p. 25].

In 2020, the Polish ICT market grew to $ 19.3 billion.

Polish entities sold telecommunications and IT services abroad worth over PLN 37 billion in 2020 - twice as much as in 2018. The share of the ICT industry in GDP is around 8% and still growing. Overall, exports of the Polish ICT industry increased by more than 20% between 2017 and 2020 (Figure 2).

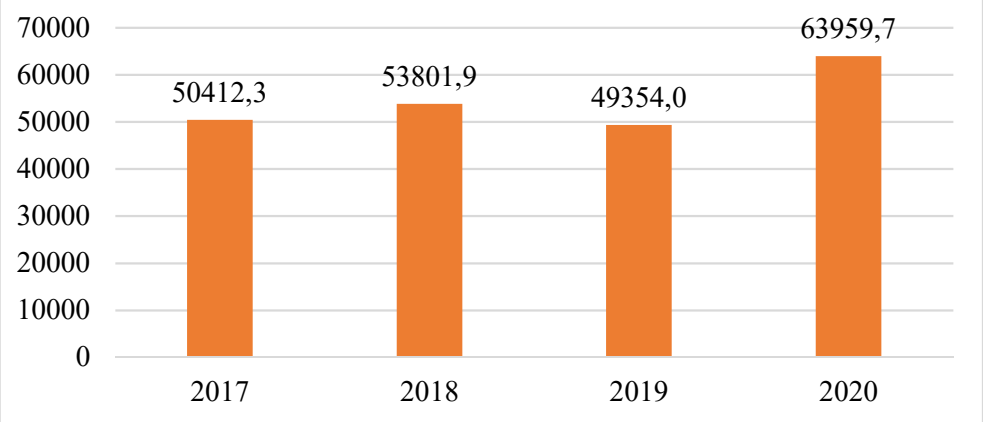

Figure 2. Net sales revenues in the ICT sector, million PLN*

**Source: compiled by the authors on the basis of [7]*

Romania. The IT industry in Romania has experienced an impressive development, especially in recent years, with more and more professionals working in this field. Romania's IT industry is one of the fastest-growing ones in Central and Eastern Europe. As of 2020, the local ICT market was estimated at $ 6.4 billion, IT exports accounted for 85% of this value ($ 5.5 billion). The highest expenditure in the IT industry in Romania was hardware-related, totaling over $ 1.1 billion. Software expenditures amounted to $ 844 million. Almost half of the total revenue ($ 2.9 billion) comes from large companies with more than 250 employees, followed by small companies (under 50 employees) contributing $ 2.2 billion, and mid-size companies (50-249 employees) bringing in $1.3 billion. The country's leading IT development city is Bucharest, which accounts for 63% of all IT revenues. In 2020, there were over 105,000 employed in the information, technology, and communications industry in Romania's capital. Moreover, Cluj recorded employment of nearly 24,000 people in the IT/ ICT industry. The Pandemic triggered an unprecedented development of the digitalization process, as many companies have shifted towards enhanced software solutions for better match-making with the client needs [14].

Ukraine. In 2020 alone, the Ukrainian IT market attracted about $ 577 million in investment, almost 90% of which came from the United States. And for the 2020-2021 period, more than $ 3.15 billion was invested in the IT market of Ukraine. Exports of IT services in 2020 amounted to $ 5.7 billion and now account for 8.3% of total exports, and the number of specialists exceeds 200,000. Less than a decade ago, in 2013, the IT industry accounted for just 1.6% of Ukrainian exports, but this share has now undergone a fivefold increase. The income of Ukrainian companies providing IT services is growing by an average of 20-25% annually. And the share of the IT industry in the GDP of Ukraine is 4.9%. A limited number of companies are put for sale, much more demand to acquire than are interested in selling. Acquirers are looking for: 1) access to ample talent pool, scalability; 2) delivery diversification; 3) vertical capabilities expansion; 4) client portfolio acquisition; 5) technical / language skills. Ukraine is a part of a global consolidation play among software development outsourcing companies. Key consolidation fundamentals include the competition for talent and market maturity. Top 5 software development outsourcing companies alone employ 15% of total IT professionals in Ukraine [17].

The permanent yet growing trend is observed for the share of employed in ICT in the total employment structure of the countries under research. High labor remuneration level, comfortable labor conditions, and strong career improvement opportunities are the main causes of growing employment in this industry (Table 1).

Table 1

ICT sector employment as a share of total employment in 2012–2020, percent)*

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020
Poland	2,1	2,2	2,3	2,3	2,7	2,8	3,0	3,1	3,4
Romania	1,9	1,9	2,0	2,3	2,0	2,1	2,2	2,3	2,4
Ukraine	0,015	0,016	0,016	0,017	0,017	0,017	0,017	0,017	0,018

**Source: compiled by the authors on the basis of [2; 3]*

The low level of employment in ICT in Ukraine is characterized by a high share of shadow employment, which is caused by a relatively high taxation level. For example, the share of employed in ICT in Ukraine is characterized by a consistent level with slight growth of 0.015-0.018 %.

The IMD Digital World Competitiveness Ranking shows that Poland demonstrates permanent but gradual growth. The country's position is improving each year, indicating the growing efficiency of transformation processes in general and in the ICT sector in particular (Table 2). Ukraine is ranked the lowest in global rankings and indices compared to its neighboring countries with transitional economies. In 2021, Ukraine was ranked 54th in the IMD Digital World Competitiveness Ranking, while Poland was 41st and Romania – 50th [20]. Meanwhile, even this level was secured by high parameters of such ranking components as training & education, and scientific concentration. It is explained by the fact that the ICT of Ukraine and Romania are more sensitive to global market conditions and domestic economic policy, which does not always impact the industry development favorably.

Table 2

The IMD World Digital Competitiveness Ranking 2016-2020*

Country	2016	2017	2018	2019	2020	2021
Poland	38	37	36	33	32	41
Romania	49	54	47	46	49	50
Ukraine	59	60	58	60	58	54

** Source: compiled by the authors on the basis of* [20, *p. 186]*

In the world, the key indicator that characterizes the state of the ICT industry is Global Connectivity Index (GCI), developed by the Chinese telecommunication company Huawei (Table 3).

Table 3

The Global Connectivity Index 2016-2020*

Country	2016	2017	2018	2019	2020
Poland	39	35	34	36	51
Romania	35	37	35	37	50
Ukraine	55	55	54	50	43

**Source: compiled by the authors on the basis of [5]*

According to the Global Connectivity Index, Ukraine was ranked 43rd among 79 countries in the world in 2020. Among the neighboring countries, Romania (50th position) and Poland (51st position) had slightly lower rates. It is worth mentioning that Ukraine was categorized as a follower, i.e. the country with an average level of the use of modern digital technologies. Yet, unlike other countries, Ukraine has quite a high level of ICT use in economic activity at a very low GDP per capita rate [5].

Networked Readiness Index (NRI) is an integral parameter that characterizes the level of ICT development in different countries. By its content, NRI shows the innovative-technological capacity of the countries globally and prospective opportunities for digital technologies development for each of them. In 2021, Networked Readiness Index encompassed 130 countries that generated about 95 % of global GDP [12]. The Netherlands was ranked first by NRI with an 82.06 rate (Figure 3).

It is worth emphasizing the positive changes for the USA with the rankings growth from the eighth position to the fourth in 2021. The Index rates for these countries confirm their strong readiness for networking.

Ukraine was ranked 53rd in 2021 with a 55.70 rate by Networked Readiness Index. Its position improved by 11 points compared to the previous year. Yet, it still lags far behind the

European countries. Ukraine was first in the group of countries with above-average income, proceeded by Vietnam (63rd place) and India (67th place). Poland and Romania had better positions. Poland was 33rd with a 64.33 rate, and Romania was 47th with a 56.54 rate [12].

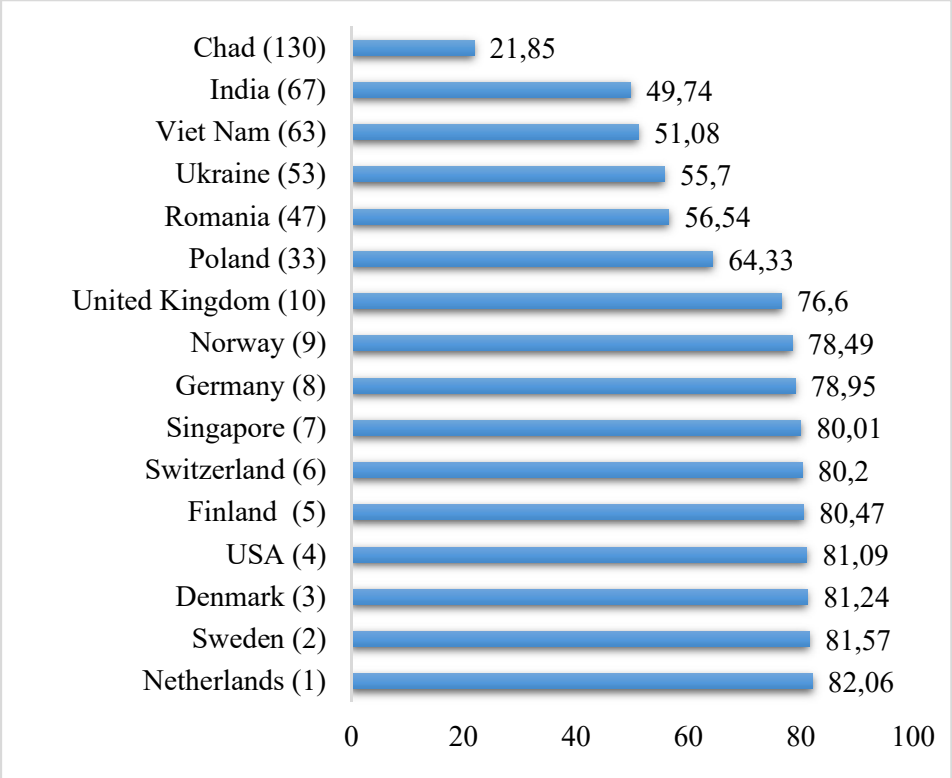

Figure 3. Networked Readiness Index of some countries and countries with transformational economies in 2021*

**Source: compiled by the authors on the basis of [12]*

Such indicator as the number of Internet users per 100 inhabitants has a particular impact on the development of the ICT industry and acceleration of structural changes in the national economy in general. The influence of the Internet consists in providing wide access for users to up-to-date knowledge and current information, boosting significantly the efficiency of economic activity.

Research held by the International Telecommunication Union (ITU) shows that broadband Internet networks are vital national infrastructure. Mobile broadband services, which tend to be cheaper than fixed broadband services, have increased rapidly and provide the most common means of access to the Internet and online services. The number of active mobile broadband subscriptions increased to 92 % in 2021. In developing countries, penetration rates of active mobile broadband subscriptions reached 67.5 per 100 inhabitants in 2020. In the least developed countries, penetration rates went up from virtually zero in 2007 to 36.3 subscriptions per 100 in 2020 [9].

It is obvious that the number of internet users per 100 inhabitants in highly developed countries is much higher than in other countries worldwide. In particular, Figure 4 shows that it is the highest in the European countries because this region has a high level of GDP per capita, national income, and other macroeconomic indicators, which determine the high level of the ICT industry development, a greater integration level of European companies into the global production networks, and the service sector development.

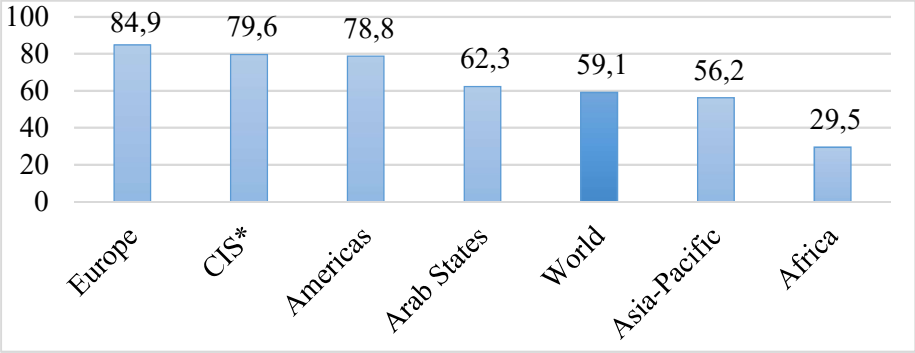

Figure 2. Individuals using the Internet per 100 inhabitants, 2020*

***CIS – The Commonwealth of Independent States*

**Source: compiled by the authors on the basis of [9]*

Of course, the rate is different across the continent and is the highest in the highly developed countries in Europe. However, even in European countries with the transitional economy, the rate is much higher than the world average (Table 4).

Table 4

Percentage of Individuals using the Internet in some European countries*

Country	2000	2006	2012	2018	2019	2020
Bosnia and Herzegovina	1.08	25.12	45.06	70.12	69.95	73.21
Bulgaria	5.37	27.09	51.90	64.78	67.95	70.16
Croatia	6.64	37.98	61.94	75.29	79.08	78.32
Estonia	28.58	63.51	78.39	89.36	90.23	89.06
Hungary	7.00	47.06	70.58	76.07	80.37	84.77
Latvia	6.32	53.63	73.12	83.58	86.14	88.90
Lithuania	6.43	43.90	67.23	79.72	81.58	83.06
North Macedonia	2.49	28.62	57.45	79.17	81.41	81.41
Poland	7.29	44.58	62.31	77.54	80.44	86.84
Romania	3.61	24.66	45.88	70.68	73.66	78.46
Slovak Republic	9.43	56.08	76.71	80.66	82.85	89.92
Ukraine	0.72	4.51	35.27	62.55	70.13	67.01

**Source: compiled by the authors on the basis of [22]*

Moreover, the gap between the highly developed countries and the rest of them by this indicator decreases rapidly every year, and in some countries, in particular, the Slovak Republic, it is even one of the highest in the world. Accordingly, this has a direct connection with the ICT industry development since it is one of the basic industries of the national economy in the Slovak Republic that provides 4.2% of the country's GDP.

Together with the increase in the ICT development level in European countries with transitional economies, there is an increase in economic growth rates in these countries, which are already higher than even the growth rate of the European economy in general (Table 5).

Table 5

Real GDP growth (Percent change from previous year, USD)*

Country	2017	2018	2019	2020	2021e	2022f	2023f
World	**3.2**	**3.0**	**2.6**	**-3.4**	**5.5**	**4.1**	**2.3**
Advanced economies	2.4	2.2	1.7	-4.6	5.0	3.8	3.2
Eurozone	2.5	1.9	1.6	-6.4	5.2	4.2	2.1
Bulgaria	3.5	3.1	3.7	-4.2	3.3	3.8	3.6
Croatia	3.1	2.7	3.5	-8.1	9.4	5.4	4.4
Hungary	4.3	5.1	4.6	-4.7	6.8	5.0	4.3
North Macedonia	0.2	2.9	3.9	-6.1	4.0	3.7	3.4
Moldova	4.7	4.0	3.7	-7.0	6.8	3.9	4.4
Poland	4.9	5.1	4.7	-2.5	5.1	4.7	3.4
Romania	7.1	4.0	4.2	-3.7	6.3	4.3	3.8
Ukraine	2.5	3.3	3.2	-4.0	3.4	3.2	3.5

Aggregate growth rates calculated using GDP weights at average 2010-19 prices and market exchange rates.

e = estimate; f = forecast.

**Source: compiled by the authors on the basis of [19]*

However, the projected indicators for 2022-2023 obviously need correction in view of the 2020 global economic crisis, which is intensified by the spread of the COVID-19 pandemic.

Manufacturing in the European countries has undergone extended transformations in recent decades, including deindustrialization, outsourcing, globalization, changes to business paradigms (such as just-in-time manufacturing), the growing importance of digital technologies, and concerns linked to sustainable production and the environment. Furthermore, the performance of manufacturing in the European countries has become increasingly linked to the competitiveness of (business) services, insofar as many manufactured goods contain a growing share of services inputs: for example, logistical support, research and development, design, computer services, advertising and marketing [4].

In general**,** computer programming, consulting, and related activities have the following features in European countries: the sector is male-dominated, and younger workers (25–39 years) are overrepresented; there is an above-average incidence of restructuring and the introduction of new technology; work-life balance is better than in the EU28 as a whole; there is a high incidence of employer-paid training; the majority of workers have high levels of both work intensity and job autonomy; exposure to physical risks is low; ob quality is above the EU 28 average [1].

Scientific and technological progress becomes more regulated and, at the same time, unpredictable because the models of corporate management with a horizontal communication system dominate here. Therefore, the business rather than the public sector is the main generator of innovations. Startups get more and more opportunities regarding both the resource attraction and market promotion or popularization in the society.

The gaps are even larger in the broader fields of technology related to the access to a wider scope of information and the possible transition from content consumption to its production,

and they are increasing. Countries with a low level of human development have the least progress in these technologies - a trend comparable to the growing gap in the capacity of established broadband communication channels, especially in absolute estimates [6].

The important thing today is that the comprehensive digitalization of socio-economic relations has another colossal advantage, namely its role in overcoming the pandemics of the 21st century. In particular, today, with the current COVID-19 coronavirus spread, modern digital technologies allow the prompt providing of information to the population about the threat and conducting the global monitoring of the current situation with the spread of the virus by a quick search of possible ways for its prevention. Moreover, they ensure that economic activity is conducted virtually in many areas and industries, without physical contact between people, which is especially important for the national economy during quarantine.

Essentially, automation and informatization of economic processes are the major phenomena of intense structural changes in the economy. The phenomena have both positive and negative effects. On the one hand, automation allows reducing the amount of routine work, raising productivity, increasing the accuracy of workflows, and also reducing the costs. On the other hand, automation changes the structure of the labor market, replacing an increasing number of employees forced to look for a workplace in other areas or even other economic sectors.

Meanwhile, informatization can be seen as an alternative opportunity to increase employment since the expansion of opportunities to collect data coming from different sources requires prompt data processing and storage, as well as a timely and correct application for making optimal decisions. However, the complexity of processing and protecting a large array of data requires the availability of highly qualified specialists, generating an increase in company costs.

Consequently, cybersecurity is another very important rapidly developing ICT industry component.

The world's leading tech association, in its IT Industry Outlook 2020 research, notes that the theme of cybersecurity has been a shift from a purely defensive mindset to a proactive approach combining technology, process, and education over the past decade [8, p. 13]. Subsequently, the shift will move from cybersecurity as an IT component to cybersecurity as a critical business function. When treated as part of IT, a proactive approach to cybersecurity may still struggle to get the proper budget allocation or properly demonstrate value to the business. As a result, organizations are beginning to treat cybersecurity as a dedicated function. At large enterprises, this usually takes the form of a CISO managing a team of resources, and the division is more clear. For everyone else, establishing a cybersecurity center of operations is much less formal and involves a blend of internal and external resources. The process starts with defining risk tolerance, a step that most companies are not familiar with after simply placing all corporate content behind a secure perimeter. The next step is to fill the skill gaps that exist, which has become a difficult task with so many different areas under the umbrella of security. Finally, there must be metrics to measure the return on a more significant investment. Separating cybersecurity from IT and taking these steps elevates the function to that of a critical business operation, on par with legal assistance or accounting. For third parties providing security services and technical employees with security responsibilities, the transition will not take place overnight, but there will be notable progress throughout the year.

Mobile banking, digital identification, and e-commerce have helped a great number of people to save money and run their businesses safely, without requiring significant cash,

insuring themselves against risks, and borrowing funds for their business development and entering new markets.

The same report argues that the increase in e-commerce has also been significant, considering the individuals and small businesses selling goods and services using social networks. In particular, inclusive e-commerce, which facilitates the participation of small businesses in the digital economy, has considerable importance because it can create new opportunities for traditionally excluded groups. For example, in China, approximately 10 million small and medium-sized enterprises make sales using the Taobao platform, almost half of the entrepreneurs on the platform are women, and more than 160,000 people with disabilities [8].

Broad access to financial services is the opportunity of access to and use of a number of relevant needs and responsibly provided financial services in a well-managed environment [18].

Therefore, ICT plays an important role in determining competitiveness, employment, and economic growth. It creates new opportunities at the same time that it makes some of the existing production, communication, and distribution processes increasingly unviable. In doing so, ICT has the potential to change the spatial division of labor and production both within and across countries, sectors, and enterprises. Developing countries need to evaluate proactively the impact of ICT on existing sectors, identify the potential for ICT to create new economic and social opportunities, and address development priorities by designing and implementing comprehensive national ICT strategies [13].

Meanwhile, the program-target management method is an important tool ensuring the ICT industry development nowadays. Moreover, the issue of the ICT industry development is displayed not only in the development strategies of large cities in highly developed and developing countries but also in state programs of countries with a low level of socio-economic development. It emphasizes the role of the ICT industry in the implementation of the large-scale changes in the sectoral structure of the national economy. Today, most countries worldwide have national strategies or programs for ICT industry development.

Ukraine's Export Strategy emphasizing the importance of the ICT industry puts the main focus on the development of favorable institutional and regulatory preconditions and target awareness-raising and educational events that should stimulate trade innovativeness and diversification. This is extremely important for ensuring the country's competitiveness as the share of knowledge-intensive and innovative products has decreased in recent years on average by 2.5 % both in the export and GDP structure.

Customization, being the process of product adjustment to the needs of a specific customer, taking into account the features of the latter, is another stimulating factor in the IT technologies development. Customization provides many possible options in programming for the ICT industry enterprises in the shortest period of time at almost fixed costs. It is almost impossible to achieve this in manufacturing or agriculture without changing the equipment, technology, infrastructure, etc. In turn, it stipulates the essential increase in money and time costs. Besides, today IT customization is a necessary process solution for the creation of new products in other economic industries as it is secured by the high flexibility of project activity.

Thus, IT customization can be defined as the process of programming and modeling of new goods and services using ICT technologies based on the set parameters with the view to achieve their uniqueness and gain competitive advantages according to the requirements of a specific user or consumer group.

Moreover, IT clusters are the most common form of ICT industry development in developing countries of Europe. In this regard, Poland can be a particularly good example as several dozens of clusters function successfully there. Clusters are a convenient form,

because ICT entities, which are not only competing but also cooperating with each other, are placed in a restricted area with high-quality infrastructure. The competition encourages firms to be always in tone and maintain a high level of competitiveness. Simultaneously, cooperation enables firms to join efforts for the realization of great high-tech projects, reduce aggregate costs on a scale effect basis, share experience, receive expert assistance, and have a direct open dialogue with the public sector, thereby getting the synergy effect in business. In addition, it provides integration into the channels of knowledge, resources, and products distribution, etc. And since clusters are often created with the support, and even on the initiative of local authorities and governments, this is often accompanied by incentive preferences such as preferential real estate rent, tax cuts for cluster members, their promotion on public information channels, and public-private partnership in joint projects.

Conclusions and perspectives of further research work. Overall, ICT development allows reducing the gap between highly developed countries and countries with transitional economies. This trend is confirmed by the convergence in the access to a broadband Internet connection, mobile communication, the number of computers per 100 users, etc. However, highly developed countries have more capacity to create critical technologies or radical innovations, as argued by S. Kuznets. Such an advantage, especially on the verge of another technological revolution, can cause a divergent effect, i.e exacerbate the inequality between rich and poor countries.

An interesting fact is that the ICT development boosts the development of market opportunities and thus the capitalization of online platform companies and social operators due to the network effect since the more users get access to the Internet and mobile communication, the more potential customers in these companies are. The problem is that almost all of these companies are residents of highly developed countries, and even if a successful startup emerges in another group of countries with a lower level of socio-economic development, it will probably be absorbed by companies from richer countries, only adding to the disparity between countries.

Additionally, the ICT industry development in these countries can also be accompanied by some ambiguous influences on the system of the national economy in general. Firstly, the rapid ICT industry development in the European transitional economies (ETE) is clearly of the export nature, which is conditioned not only by more solvent demand in the markets of highly developed countries but also by weak domestic demand for ICT products within the ETEs. Moreover, although the amount of ICT products in the export structure of ETE countries is not significant yet but the ICT indystry can already be considered as one of the export accelerators by the growth rate. Secondly, 80-90% of ICT products are exported from these countries on an outsourcing mechanism basis. It provides companies with a quick operating income, however, the transfer of exclusive rights to ICT objects reduces the potential revenues from the commercialization of intellectual property rights in the future, in particular from the sale of license rights.

In general, these two factors reduce, to some extent, the flexibility of the ICT industry in the ETE countries in conditions of the high volatility of global markets and external threats overall. It also slightly limits the industry's potential to be a major driver of economic growth within the national economy.

However, it is worth mentioning that the increase of the national economy capitalization is the key positive effect achieved as a result of the ICT industry development since the industry is characterized by a high level of added value and a high level of intellectual capital, which, in addition to the accumulation of more direct investments, also provides a rather

powerful diffusion of high-quality modern knowledge, not only within the industry but also in the whole national economic system.

Overall, the main factors of such a rapid development of the ICT industry in the Central and Eastern European countries with transitional economies are the following:

- high qualification of specialists;
- rapid development of IT academies, both integrated into public universities and private educational institutions of large companies;
- the ability to adapt to market needs, market conditions, technology, and new standards;
- well-developed IT infrastructure, including a high level of network readiness and active development of regional IT clusters;
- high quality of software products presented on the global market at competitive prices;
- the absence of rigid state regulation of the ICT industry and a favorable tax climate expanding its operating conditions.

Thus, the ICT industry has a transforming ability to make significant structural changes in the national economic system, impacting the organization and structure of the labor market, the system of financial instruments and operations, expanding the access to resources and markets, stimulating the development of civil society institutions, and increasing the management efficiency.

Referenses

1. Computer programming, consultancy and related activities: Working conditions and job quality. Eurofound. 2015. Retrieved from https://www.eurofound.europa.eu/ publications/ information-sheet/2015/working-conditions/computer-programming-consultancy-and-related-activities-working-conditions-and-job-quality# (accessed 2 March 2022)
2. Employed ICT specialists. Eurostat. 2020. Retrieved from https://www.ec.europa.eu/ eurostat/ databrowser/view/ISOC_SKS_ITSPT/default/table?lang=en. (accessed 15 March 2022)
3. Employed population by type of economic activity in 2000-2020. Ukrstat. 2020. Retrieved from https://www.ukrstat.gov.ua/operativ/operativ2014/rp/zn_ed/zn_ed_u/ zn_ed_2013_u.htm (accessed 23 February 2022)
4. Eurostat regional yearbook. Luxembourg: Publications Office of the European Union. 2019. 226 p. Retrieved from https://www.ec.europa.eu/eurostat/documents/ 3217494/ 10095393/KS-HA-19%E2%80%91001-EN-N.pdf/d434affa-99cd-4ebf-a3e3-6d4a5f10bb07 (accessed 15 March 2022)
5. Global Connectivity Index (2020). Retrieved from https://www.huawei.com/minisite/ gci/en/country-rankings.html (accessed 15 March 2022)
6. Human Development Report. United Nations Development Program. 2019. 368p. Retrieved from https://www.hdr.undp.org/ (accessed 9 March 2022)
7. Information society in Poland in 2021. Statistics Poland. Statistical Office in Szczecin. 2021. 176 p.
8. IT Industry Outlook 2020. CompTIA. 2020. Retrieved from https://www.comptia.org/ content/research/it-industry-trends-analysis/ (accessed 2 March 2022)
9. Key ICT indicators for developed and developing countries, the world and special regions (totals and penetration rates). World Telecommunication / ICT Indicators database. ITU. 2020. Retrieved from https://www.itu.int/en/ITU-D/Statistics/Pages/stat/ default.aspx (accessed 21 February 2022)
10. Kravchenko V.N. Transformation processes and conceptions of the economy growing. Modeling. Analysis. Management. 2009. Retrieved from https://www.modeling.at.ua/ publ/8-1-0-29/ (accessed 21 February 2022)

11. Nepelski D., De Prato G. The structure and evolution of ICT global innovation network. *Industry and Innovation*. 2018. Vol. 25. Issue 10. P. 940-965.
12. Network Readiness Index 2021. Benchmarking the Future of the Network Economy. Retrieved from https://www.networkreadinessindex.org (accessed 23 February 2022)
13. Role of UNDP in information and communication technology for development. UNDP. 2019. Retrieved from http://web.undp.org/execbrd/pdf/DP2001CRP8.PDF
14. Romania as an IT Outsourcing 4.0 Destination: Market Overview. Retrieved from https://www.rinf.tech/romania-as-an-it-outsourcing-4-0-destination-market-overview/ (accessed 5 March 2022)
15. Sidenko V.R. Global structural transformations and trends in Ukrainian economy. Part 1. Key Trends in Structural Economic Changes in the World and Ukraine. *Economics and forecasting*. 2018. Vol. 1. P. 37-57. Retrieved from http://nbuv.gov.ua/UJRN/ econprog_2018_1_4 (accessed 15 February 2022)
16. Stamford Conn. Gartner Forecasts Worldwide IT Spending to Grow 5,1% in 2022. Retrieved from https://www.gartner.com/en/newsroom/press-releases/2022-01-18-gartner-forecasts-worldwide-it-spending-to-grow-five-point-1-percent-in-2022 (accessed 3 March 2022)
17. Sysoyev Y., Sychikova Yu., Henni A. (2021). The DealBook of Ukraine: 2021 edition. Retrieved from https://www.usukraine.org/content/on-the-digital-frontier-the-dealbook-of-ukraine-2021-with-yuliya-sychikova-adrien-henni/ (accessed 17 February 2022)
18. United Nations Capital Development Fund (2019). Retrieved from https://www.uncdf.org/ bfldcs/executive-summary (accessed 15 February 2022)
19. World Development Indicators: Individuals using the Internet (% of population). World Bank. 2021. Retrieved from https://data.worldbank.org/indicator/ IT.NET.USER.ZS ?most_recent_value_desc=flse (accessed 1 March 2022)
20. World Digital Competitiveness Ranking 2021. IMD World Competitiveness center. 2021. 186 p. Retrieved from https://www.imd.org/centers/world-competitiveness-center/rankings/ world-digital-competitiveness/ (accessed 3 March 2022)
21. Yamada K., O'Connell A. Forecast Analysis: Servers, Worldwide. 2022. Retrieved from https://www.gartner.com/en/documents/4010690-forecast-analysis-servers-worldwide (accessed 2 March 2022).
22. 2021 Review – Microsoft and Amazon Dominate IT Vendor Revenue and Growth Ranking. Retrieved from https://www.srgresearch.com/articles/2021-review-microsoft-and-amazon-dominate-it-vendor-revenue-and-growth-ranking (accessed 3 March 2022).

РОЛЬ ІНФОРМАЦІЙНО-КОМУНІКАЦІЙНИХ ТЕХНОЛОГІЙ В СТРУКТУРНИХ ЗМІНАХ ЄВРОПЕЙСЬКИХ КРАЇН З ТРАНСФОРМАЦІЙНИМИ ЕКОНОМІКАМИ

Світлана Урба[1], Ігор Назаркевич[2], Богдан Васильків[3], Лілія Палащин[4]

Львівський національний університет імені Івана Франка
79008 м. Львів, проспект Свободи, 18
[1]e-mail: svitlana.urba@lnu.edu.ua; ORCID ID: https://orcid.org/0000-0003-1778-8845
[2]e-mail: nazigor22@gmail.com; ORCID ID: https://orcid.org/0000-0001-5856-531X
[3]e-mail: vasylkivb.l.777@gmail.com; ORCID ID: https://orcid.org/0000-0003-4469-8239
[4] e-mail: liliya.palashchyn@lnu.edu.ua

Анотація. Досліджено вплив ІКТ-сектору на характер структурних змін в європейських трансформаційних економіках. Обґрунтовано роль ІКТ-індустрії як акселератора експорту для європейських трансформаційних економік та їх вплив на

розвиток глобальних ринків. На основі процесного підходу до управління рішеннями в ІКТ-індустрії запропоновано дефініцію ІТ-кастомізація.

Проаналізовано особливості та динаміку розвитку сектору інформаційно-комунікаційних технологій в транзитивних економіках країн Центральної Європи за такими показниками, як: Світовий рейтинг цифрової конкурентоспроможності країн, Глобальний індекс підключення, Індекс мережевої готовності, кількість користувачів інтернету на 100 мешканців. Досліджено вплив ІКТ-індустрії на інтенсивність структурних змін в трансформаційних економіках.

Розглянуто сучасні форми стимулювання розвитку ІКТ-індустрії. Зазначено, що найбільш поширеною формою розвитку ІКТ-сектору в країнах Європи, що розвиваються, є ІТ-кластери. Вони забезпечують розвиток суб'єктів ІКТ-сектору на обмеженій території з високоякісною інфраструктурою, які не лише між собою конкурують, але й кооперуються. Це дозволяє їм інтегруватися в канали розповсюдження знань, ресурсів, продукції тощо. Оцінено позитивні та негативні ефекти використання інформаційно-комунікаційних технологій в європейських трансформаційних економіках.

Авторами доведено, що головними факторами стрімкого розвитку ІКТ-сектору в європейських країнах з транзитивною економікою повинні бути: високий рівень кваліфікації фахівців; створення ІТ-академій, які повинні бути інтегровані як в державних університетах, так і в приватних при великих компаніях; швидка адаптація до потреб ринку, змін ринкової кон'юнктури, технологій та нових стандартів; високий рівень мережевої готовності та активний розвиток регіональних ІТ-кластерів; висока якість програмних продуктів, представлених на глобальному ринку; відсутність жорсткого державного регулювання ІКТ-індустрії та сприятливий податковий клімат.

Ключові слова: ІКТ-сектор, трансформаційна економіка, структурні зміни, ІТ-кастомізація, інновації.

Стаття надійшла до редколегії 11.07.2022
Прийнята до друку 29.11.2022