DIGITAL REALITY SCIENTIFIC AND PRACTICAL FORUM 2021

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

ІНФОРМАЦІЙНІ СИСТЕМИ ТА ТЕХНОЛОГІЇ ІСТ-2021

ПРАЦІ
X МІЖНАРОДНОЇ НАУКОВО-ТЕХНІЧНОЇ КОНФЕРЕНЦІЇ

13 – 19 вересня 2021 року
Харків - Одеса, Україна

Ministry of Education and Science of Ukraine
National Academy of Sciences of Ukraine
Polish Academy of Science, Branch in Lublin
Representative office „Polish Academy of Science” in Kyiv
Kharkiv National University of Radio Electronics
Science and Technological University Akademia Gorniczo-Hutnicza
named after St. Staszic in Krakow
Vasyl Stefanyk Precarpathian National University
Admiral Makarov National University of Shipbuilding in Mykolayiv
Zaporozhye National University
Academy of Applied Radioelektronics Sciences of Ukraine, Russia and Belarus
Ukrainian Oil and Gas Academy
Ukrainian Federation of Informatics
Belarus State University of Informatics and Radioelectronic
Belarus National Technical University

INFORMATION SYSTEMS AND TECHNOLOGIES IST-2021

Proceedings
of the 10-th International Scientific and Technical Conference

September 13-19, 2021
Kharkiv - Odesa, Ukraine

Kharkiv - Odesa 2021

Міністерство освіти та науки України
Національна академія наук України
Люблінський відділ Польської Академії Наук
Представництво „Польська академія наук” у Києві
Харківський національний університет радіоелектроніки
AGH науково-технологічний університет ім. Ст. Сташіца в Кракові
Прикарпатський національний університет ім. В. Стефаника
Національний університет кораблебудування ім. адмірала Макарова
Запорізький національний університет
Академія Наук Прикладної Радіоелектроніки
Українська нафтогазова академія
Українська Федерація Інформатики
Білоруський державний університет інформатики та радіоелектроніки
Білоруський національний технічний університет

Інформаційні системи та технології ІСТ-2021

П Р А Ц І

10-ї Міжнародної науково-технічної конференції

13-19 вересня 2021 р.
Харків - Одеса, Україна

Харків – Одеса 2021

УДК: 004.9

Наукові редактори: *А.Д. Тевяшев - доктор технічних наук, професор (Харківський національний університет радіоелектроніки);*
Л.Б. Петришин - доктор технічних наук, професор (AGH University of Science and Technology; Прикарпатський національний університет ім.В.Стефаника);
В.В. Безкоровайний - доктор технічних наук, професор (Харківський національний університет радіоелектроніки);
В.Г. Кобзєв – кандидат технічних наук, старший науковий співробітник (Харківський національний університет радіоелектроніки)

Матеріали статей рецензовано та опубліковано в авторській редакції.

Рецензенти: *Л.Б. Петришин – UST AGH, Польща; Б.О. Железко – БНТУ, Білорусь; Н.Г. Аксак, В.В. Безкоровайний, Є.В. Бодянський, А.Л. Єрохін, Л.О. Кіріченко, В.Г. Кобзєв, С.В. Машталір, К.Е Петров, Т.В. Полозова, О.Г. Руденко, І.В. Свид, А.Д. Тевяшев, В.О. Філатов – ХНУРЕ, Україна; О.В. Бісікало, Ю.О. Гунченко – ОНУ, Україна; С.О. Іванченко – НТУУ КПІ, Україна; Н.Ф. Казакова, О.О. Фразе-Фразенко – ОДЕКУ, Україна; В.В. Карасюк – НЮУ, Україна; В.А. Лужецький – ВНТУ, Україна; Л.І. Нефьодов – ХНАДУ, Україна; В.М. Синєглазов – НАУ, Україна; С.В. Чопоров – ЗНУ, Україна; Н.В. Шаронова – НТУ КПІ, Україна; І.В. Шевченко – КрНУ, Україна; О.О. Шумейко – ДГТУ, Україна; С.В. Яковлев – НАКУ ХАІ, Україна, Evgeni Schumm - Hochschule Hamm-Lippstadt, Німеччина*

Інформаційні системи та технології: праці 10-ї Міжнародної науково-технічної конференції, Харків-Одеса, 13-19 вересня 2021 року / наук. ред. А.Д. Тевяшев, Л.Б. Петришин, В.В. Безкоровайний, В.Г. Кобзєв. – Х.: ХНУРЕ, 2021. – 357 с.

ISBN 978-617-7519-59-0

Збірка містить матеріали статей Міжнародної науково-технічної конференції з проблем сучасних інформаційних систем та технологій.
Праці представляють інтерес для фахівців, науковців і аспірантів, діяльність яких пов’язана з розробкою та впровадженням сучасних інформаційних систем і технологій.

Digital Industry in Ukraine: challenges and perspectives

Tetiana Polozova [1], Iryna Sheiko[2], Irina Kolupaieva[3], Vasyl Otenko[4]

[1, 2, 3] *Kharkiv National University of Radio Electronics, Nauky Avenue, 14, Kharkiv, 61166, Ukraine*
[4] *Simon Kuznets Kharkiv National University of Economics, Nauky Avenue, 9a, Kharkiv, 61166, Ukraine*

Abstract
The article considers the issues of digitalization of Ukrainian industry. The experience of European countries in the formation of digitization policies at the national level is analyzed, as well as the first results of the implementation of such policies are evaluated. Prospects for the development of digital technologies in the industry of Ukraine are considered. It is noted that the main challenges to digital development are the high level of corruption in the country, external threats, political risks, low level of investment by foreign investors. The impact of the pandemic on the growth of the information technology sector in Ukraine is also assessed. Thus, the development of Ukraine's digital economy is a crucial factor for the success, competitiveness of Ukrainian business on the global market, as well as for attracting investment to the country. But also a necessary condition is the state support of digitalization processes without attempts of over-regulation.
Keywords
Digitalization, industry 4.0, productivity, IT sector, COVID-19 pandemic, cybersecurity.

1. Introduction

Digitalization becomes the frontier of innovations in industry and social services. All countries at global level provided actions to improve their digital development. The global economy is rapidly becoming digital. Information and Communications Technology (ICT) is no longer a specific sector but the foundation of all modern innovative economic systems. The Internet and digital technologies are transforming production process worldwide. Industry 4.0 or Manufacturing Internet of Things (IoT) systems connect the components of a production process in a factory. Their purpose is to enable "smart manufacturing". In smart factories, cyber-physical systems monitor physical processes and make decentralized decisions. Via their IoT connection, these cyber-physical systems can communicate and cooperate with each other and with humans in real time. Connected devices include manufacturing equipment and robots.

That is why it is important to analyze the current perspectives of Ukrainian business sector in digitalization global processes.

In this paper we analyze the digitalization trends in EU members, including digital industry policies and summarize the main perspectives and challenges for Ukraine in global digital production. It is also important to conduct an impact of COVID-19 pandemic in intensity of digitalization worldwide and in Ukraine.

EMAIL: tetiana.polozova@nure.ua (A. 1); irina.sheiko@nure.ua (A. 2), iryna.kolupaieva@nure.ua (A. 3); ovi@hneu.edu.ua (A. 4)
ORCID: 0000-0001-9956-8816 (A. 1); 0000-0002-5770-3677 (A. 2); 0000-0003-1256-0817 (A. 3); 0000-0002-5979-1084 (A. 4)

2. Current tendencies in Digital industry policies

Three industrial revolutions have led to changes in the domain of manufacturing – mechanization through water and steam power, mass production in assembly lines, and automation using information technology. However, over the past years, industries together with researchers and policy makers worldwide have increasingly advocated an upcoming fourth industrial revolution.

Scientists pay a lot of attention to the impact of information technology and digitalization on economic development.

C. Foster & S. Azmeh [8] investigated national digital policies, with a focus on China, they proved that these policies often aim at facilitating global integration and linkages.

Author's analysis shows that, under certain conditions, more interventionist approaches can be vital in countering structural challenges, such as power of digital platforms, limitations of domestic digital firms, limited ability to leverage digitalization for broad-based national development.

Bart Van Ark et al. [1] confirmed that in the 90s of XX century, European economies were not able to utilize the potential of the digital economy so effectively as Canada or United States, mostly due to the restrictive regulations, that made the obstacles to a quick proliferation of the digital economy infrastructure in the sectors that were the users of ICT.

Biagi F. [2] provides literature review concerning ICT and productivity. The author concludes that ICT had a major role in the U.S. productivity acceleration observed in the period 1995-2005. Biagi also pointed out, that ICT is largely responsible for the divergence in productivity paths observed between 1995 and 2005 for the U.S. and the E.U.

T.Polozova et al [22] analyzed digital gaps between EU-members and found out, that Scandinavian countries has greater digital potential than Eastern and Central Europe countries.

World Economic Forum [20] and authors of Network Readiness Index 2020 [17] put attention to the importance of digital development for readiness of future production and post-COVID recovery.

Literature review shows the actuality of digitalization problem and importance of digital progress for economic development. But COVID-19 consequences on digitalization are less investigated due to short period of time for studying effects of pandemic on digital development. Also the results of digitalization in Ukrainian industrial sector did not receive sufficient coverage in economic press. That is why it is actual to analyze digital development in Ukraine business sector and attempts to activate digitalization by different state agencies.

2.1. Digital Industry in European Union

In recent years, the European has paid a lot of attention to the development of digital technology in Industry 4.0 under the slogan "Advanced Production". The formed working group, established in 2013, presented a working document [10], which mainly addressed the problem of reducing the share of industrial production in the GDP of the European Union. European Commission emphasized that digital technologies such as cloud computing, big data, the new industrial Internet, applications, smart factories, robotics and 3D printing had become prerequisites for increased productivity in the industry of the EU. The European Commission has identified three objectives to support the development of digital technologies [10]: faster commercialization of advanced production technologies; reducing the deficit of demand for advanced production technologies; promotion of advanced production skills.

However, the relative contribution of industry to the EU economy is declining. Over the last 40 years, the European economy has lost one third part of its industrial base. By the third quarter of 2014, the value added of production in the EU economy was only 15.3% of total value added, which is 1.2 percentage points less than at the beginning of 2008. This "deindustrialization" is common to all developed economies, in part due to increased production in other parts of the world (including China), the relocation of labor-intensive labor to lower labor costs, and participation in global supply chains with suppliers outside the EU. Moreover, the growing services sector accounts for an increasing share of the overall European economy, leading to a lower relative share of industry [10].

Large investments are needed for companies to move to Industry 4.0. It is projected, that by 2020 Germany alone will need € 40 billion a year. These investments may be unaffordable for small and medium-sized enterprises (SMEs). Therefore, in 2014 a new EU research program "Horizon 2020" was launched - by 2020 the Commission planned to allocate 77 billion Euros of funding, including 24.4 billion Euros for "research excellence" and 17 billion Euros for industrial innovation and so-called key technologies [10].

The concept of i4.0 is based on linkage of virtual and physical parts of business processes along a supply chain. The virtualization is gained by Internet of Things (IoT), Internet of Services (IoS) and Internet of people (IoP). [20].

The European manufacturing industry is responsible for 15% of GDP. Countries with an especially large manufacturing sector include Germany and Ireland, as well as various Eastern European countries. However, for a market to be promising for Industry 4.0 services it also needs to be ready for these techniques. This depends on, for example, production process maturity, degree of automation, degree of innovation, industry openness and internet use [10].

Industry 4.0 readiness is considerably greater in western and northern Europe than in other parts of Europe. As the founder of the movement, Germany scores particularly high.

National Industry 4.0 initiatives in European Union have yielded numerous qualitative and quantitative results at the country level.

For example Germany since 2010 has contributed € 200 million to the Industrie 4.0

initiative (one of ten projects under the German High Technology Strategy 2020 Action Plan) to encourage the development of "smart factories" [12].

The United Kingdom has initiated several policies to make production more sensitive, more sustainable, more open to new markets and more dependent on skilled workers. The most well-known are high-value production centers, called "catapult centers", which help companies to gain access to research and experience in specialized areas such as advanced production and innovation processes. The goal of these centers, which have received more than £200 million in public funding since 2011, is to double the contribution of production to GDP (about 10% in previous decades) [12].

In April 2015, France launched the Industry of the Future plan (Alliance pour l'Industrie du Futur) to set up demonstration centers to demonstrate new products and services. This program has implemented more than 800 loans to companies and drawn up 3,400 business plans, while the Swedish P2030 project has financed 30 projects involving more than 150 companies [12].

In Poland the Future Industry Platform was announced as part of the Responsible Development Plan ('Morawiecki Plan') by the Ministry of Finance and Development in 2016 [7]. Providing industrial financing over a 25-year period, the Morawiecki Plan pursues an agenda of reindustrialisation through new partnerships, export-oriented support measures and comprehensive regional development. With a total planned investment of €235 billion over the next 25 years, the Plan seeks to unleash the potential of the economy to achieve development that improves the quality of life in Poland [21].

Průmysl 4.0 (Industry 4.0) is a national initiative aiming to maintain and enhance the competitiveness of the Czech Republic in the wake of the Fourth Industrial Revolution. The national innovation fund (€1.87 million) brings together financial resources from the European Structural and Investment Funds, and additional €1.2 million from the private sector and it is considered as a possible source of a refundable form of financial support, of which part would be reinvested in the new projects [3].

European experience in the operation of programs to support the development of digitalization in industry can serve as a basis for modernizing the industrial base of the Ukrainian economy and to create an action plan to support the development of innovation and advanced technologies. Analysis of digitalization processes and their regulation in EU-members can be basis for comparing digitalization intensity in Ukraine and European countries.

To investigate impact on digitalization processes on economic development and labor productivity such data were used: cross-section data for European Union countries (EU-28), published by statistical office of the European Union [11]; Digital Economy and Society Index (DESI) [5], KOF Globalization Index [14], the Global Competitiveness ranking [6-7].

On the basis of EU-28 data for 2015-2020 the correlation between DESI index and labour productivity was found (fig. 1)

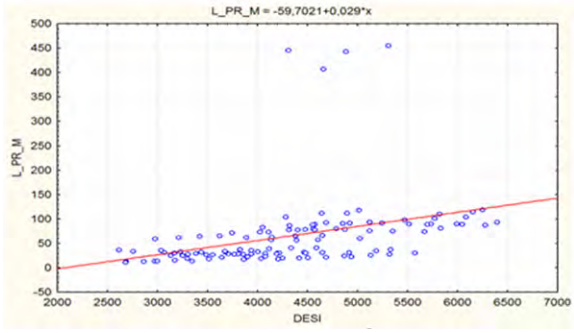

Figure 1: Relation between DESI Index and Labour Productivity level for EU-28 countries

Source: constructed by authors

Also on the base of EU-data with the data of 8 global countries (USA, China, Korea Rep., Japan, Australia, Canada, Norway and Brazil) the influence of digital development on improvement of country's competitiveness ranking was studied (Fig. 2)

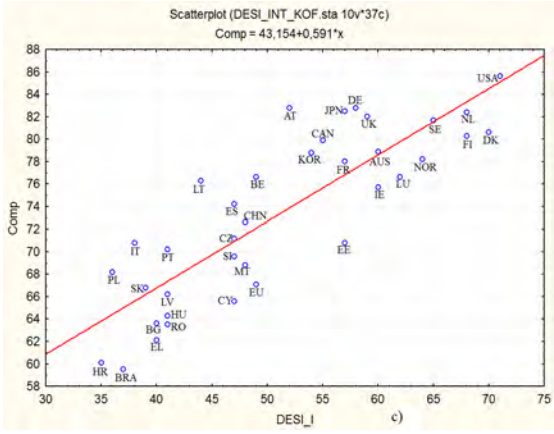

Figure 2: Correlation between DESI International Index and Global Competitiveness Index

Source: constructed by authors

Due to multiple regression modeling on the base of EU-members and 8 global competitors (USA, China, Korea Rep., Japan, Australia, Canada, Norway and Brazil) on the newest

available data (KOF Globalization Index, revised in 2020, is based on 2018 data) such equation was received:

$$COMP = 28.34 + 0.213 \cdot KOF + 0.537 \cdot DESI\_I \quad (1)$$

where COMP - Global Competitiveness Index [6-7];

KOF – KOF Globalization Index [14];

DESI_I - DESI International Index [5]

Multiple regression modeling proved that together International DESI and KOF Index provide significant impact on the value of global competitiveness score, due to second multiple regression model. The multiple correlation coefficient regression models is above 0.84 that prove the significant quality of results. Adjusted coefficient of determination (R-square) is about 0,70: we include significant factors, that allows to explain the most part of variability of dependent variables, the rest 30% of variety is explained by residuals.

The further investigations need to find additional factors to increase the quality of regression results. Also additional studies are need to measure the impact of digital technologies on post-pandemic recovery to international business, international trade and transforming of global value chains into some "new normal" form.

Future studies, possibly with longer time series and another methodical approach, should better explore the interaction of digitalization with indicators of labor market (such as education, structural change, labor demand, human capital rating) and allows to explain differences between European countries towards digitalization policies.

2.2. Digital Challenges in Ukraine

In Ukraine, the regulatory framework for the development of the high-tech industry is represented by the following documents: draft order of the Cabinet of Ministers of Ukraine "On approval of the strategy for the development of high-tech industries until 2025 and approval of the Action Plan for its implementation" [19]; Action plan for the implementation of the strategy for the development of high-tech industries until 2020 [18]; orders of the Cabinet of Ministers of Ukraine "On approval of the Concept of development of the digital economy and society of Ukraine for 2018-2020 and approval of the action plan for its implementation" [19], "Digital Agenda of Ukraine 2020" [4], Strategy on integration of Ukraine into the European Union Digital Single Market ("Roadmap"), prepared by Ministry of Digital transformation of Ukraine [16].

The concept of the Strategy for the Development of the High-Tech Industry until 2020 also envisages the development of an export-oriented innovation ecosystem, implementation of a program to involve world high-tech leaders in production and R&D developing in Ukraine and promotion of new technologies among young people (High-Tech Nation) [7].

The "Digital Agenda 2020" project defines the main goals of digitalization in Ukraine as: stimulating the economy and attracting investments; laying the foundations for the transformation of sectors of the economy into competitive and efficient ("digitalization" of business); availability of digital technologies; creating new opportunities for the realization of human capital, development of innovative, creative and "digital" industries and businesses; development and world leadership in the export of "digital" products and services. The document also identifies the necessary steps for the digitalization of Ukraine in the fields of health, infrastructure, ecology, e-commerce, e-government, etc. [4].

According to experts' opinion from the initiative "Digital Agenda of Ukraine" [3], to reach a GDP of 1 trillion USD in 2030, it will take 3-4 years to actively stimulate the penetration of technology and innovation into the economy of such sectors that could potentially show significant growth, namely: mechanical engineering; military-industrial complex; transport and logistics; agricultural sector; food and processing industry; woodworking; metallurgy.

Also Digital Agenda of Ukraine initiative experts pointed out, that digitalization can brings such effects for Ukrainian business [4]:

– growth of high-tech segments up to 20% per year;

– increase of production capacity - up to 60%;

– an increase in the number of orders executed on time - up to 95%;

– reduction of stocks - up to 20%;

– increase of efficiency of installed equipment - up to 15%;

– reduction of equipment downtime - up to 22%;

– savings in procurement costs - up to 30%;

As for machine-building industry, due to digitalization production lines will reconfigure themselves automatically in order to optimize productivity. Some of that will be driven from

above, with production lines responding dynamically to new or amended production orders, tying in seamlessly with logistics and the wider business. Some will be driven from the product itself, communicating with the line to determine the optimal route through the production process. For example, if there is a bottleneck at some point the production line, the product will recognize this and look to see if there are other processes that might be accomplished first, and instruct the line to reroute its progress [4].

High developed traditional sectors can be a good basis for providing elements of digitalization. For Ukraine, machine building is one of the most priority and export oriented industries, where it already has world recognition. At the same time, our enterprises are critically in need of modernization and construction of modern digital models in management. Therefore, the sooner the machine-building enterprises will understand the importance of the development and implementation of: enterprise resource planning systems, supply chain management systems, production process control systems and other enterprise management systems, the sooner Ukraine will take a step towards a strong industry.

Digital Agenda argues why now and in the next 5 years in Ukraine there are no conditions for any positioning among the leaders - the advanced 20-30 post-industrial countries in the world. Instead, Ukraine can be at least a regional leader in the field of complex and science-intensive engineering services as [4]:

- programming in the field of industrial high-tech / creation of new software products, including new technologies 4.0;
- design (electrical, mechanical, electronic, technological, construction, etc.);
- industrial automation and complex engineering (including commissioning of industrial facilities);
- development and production of complex, small-batch or unique products.

Special attention should be paid to the creation of industrial clusters with the presence of high-tech areas, such as: robotics; bioengineering; 3D printing; artificial intelligence with a focus on the world market [4].

In analytical report [15], prepared on request of the Ministry of Digital Transformation of Ukraine, Composite Digitalization Index and Digital Services Trade Restrictiveness Index for Ukraine for 2016-2018 was calculated. The results of the calculation of the Digitalization Index show that the current level of digital development in Ukraine is far below the EU average and behind the new EU Member States.

The dynamics of the Digitalization Index in 2016-2018 indicates a widening in the gap between Ukraine and the EU over this period. In particular, the digitalization of the neighboring EU countries has grown faster than that of Ukraine. As a result, Ukraine has lost traction even compared to the EU countries with the lowest the Digitalization Index (Croatia, Bulgaria, and Romania) (Fig. 3)[15].

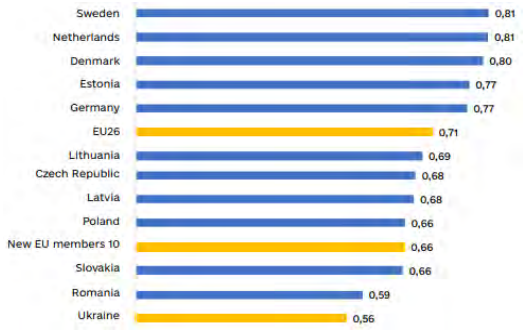

Figure 3: Comparison of the Digitalization Index of Ukraine and EU countries, 2018 [15]

Also authors of the report [15] had found out that the level of digital services trade restrictiveness in Ukraine is much higher than the EU average. For Ukraine, most barriers and regulatory differences in the digital sphere are related to cross border electronic payments and settlements, protection of intellectual property rights on the Internet, lack of practical mechanisms for the application of the electronic digital signature in foreign trade contracts, lack of mutual recognition of electronic identification and electronic trust services between Ukraine and major trading partners.

A case of successful digitalization of domestic machine-building enterprise is represented by state enterprise “FED” (Kharkiv) [13]. In 2011, the company launched a large-scale project on the implementation of an automated system for planning, accounting and analysis of Enterprise Resource Planning (ERP) business processes. And in 2013, FED launched a new project for the implementation of information technologies. Digital transformation of the business using the elements of Industry 4.0 helped the enterprise to increase the capacity of the equipment and improve delivery time. The first results of implementation were obtained during the year. Stability and reliability in terms management already then allowed the enterprise to guarantee the fulfillment of new orders from the world's leading aircraft manufacturers in the

amount of more than hundreds of millions of dollars [13].

However, the development of the digital economy depends largely on the regulatory policy of the state and the creation of favorable conditions for all major stakeholders - innovators, investors, corporations. The field where the state can influence is quite wide - from legal protection to direct funding. The main tasks of the state on the way to the digital economy are: standards - significantly increased efficiency and productivity of all staff.

2.3. Impact of COVID-19 Pandemic on Digital Development in Ukraine

The IT sphere in Ukraine is one of the most dynamic and promising. It has long been called the locomotive of the Ukrainian economy. In 2018 alone, IT services brought almost UAH 10 billion in taxes to the Ukrainian budget.

However, the Covid-19 pandemic has made adjustments to the development of information technology around the world. Many clients of IT companies before the start of quarantine in anticipation of the crisis cut all their capital expenditures on IT solutions, leaving only operating. That is, they decided to abandon investment in "hardware", physical IT solutions, such as servers and data warehouses, in favor of services under the model of licenses [23].

But according to expert opinions [15,23], the IT sector in Ukraine has suffered less than other industries. In Ukraine, more than 1,600 companies provide IT services. A feature of this industry is also the presence of a large number of self-employed professionals. Outsourcing has suffered the most in the field of information technology, especially that related to tourism. Companies focused on team optimization, operating costs, and business processes. Most IT professionals worked at home. Exceptions were technical specialists who ensure the operation of the company's infrastructure.

One of the negative factors that significantly affected the industry was that the field of information technology in Ukraine focused on customers in Western countries, actively growing with them. Now that these countries are experiencing a decline in production, the Ukrainian IT industry may also face a drop in orders.

Another response to the Covid-19 pandemic experience in the medium term is to increase the use of machines, robots and other digital technologies in production processes. By replacing human labor, automation and robotics reduce dependence on it. This trend is already in full swing, as digital technologies significantly increase productivity and reduce costs. The use of such technologies to increase resilience to crises affecting production is an additional incentive. However, not all industries and companies have the same opportunities to use digital technology to reduce their vulnerability to crises.

The COVID-19 pandemic, among other things, has raised up cybersecurity issues, as crisis situations have traditionally provoked the intensification of various hacker groups. The main factors that potentially contributed to the increase in destructive cyberactivity were: an increase in the number of potentially vulnerable connections that could compromise information or the organization itself or its employees; intensification of electronic payments, which causes increased attention of cyber criminals to fraudulent activities; increase in the number of phishing attacks - increase in fake emails (with malware attachments) and fake sites (to collect personal and banking information of citizens); further escalation of panic may be one of the goals of influence operations by other states that may wish to take advantage of the situation [23].

The biggest potential danger can be a rapid increase in the number of employees who work remotely and use IT for this purpose - often such people do not have the appropriate skills, and the state of cybersecurity of home devices is not too high. This leads to a potential increase in the number of cyber incidents (including acts of cyber espionage and compromising information).

Some organizations have completely abandoned cybersecurity tools and policies in order to somehow continue their activities.

Although the future is uncertain and no one has a clear idea about what the "new normal" state looks like, there is a high probability that many IT companies will look for an acceptable format of work, combining remote form, online meetings, team meetings in the office at a certain time.

In a changing environment, those who best adapt to new conditions win. This is especially true of the leading sectors of the IT sector, which must meet the needs of business in the organization of online and remote work, and society in the organization of interpersonal communications, education and entertainment.

3. Conclusions

The development of Ukraine's digital economy is a crucial factor for the success, competitiveness

of Ukrainian business on the global market, as well as for attracting investment to the country.

An important aspect: thanks to the introduction of the digital economy, small and medium-sized businesses have became global. Ukrainian companies can integrate into international value added networks, some of them are already successfully implemented. This is a way to increase exports and produce more complex and value added products. Such way Ukraine can significantly diversify country's export structure and geography.

Ukraine's integration into the EU's digital single market is a tool to facilitate Ukraine's digitalization in line with European and international standards. Approximation of Ukrainian legislation and standards to EU legislation and standards will reduce regulatory differences between Ukraine and the EU in the digital sphere and accelerate Ukraine's digital development.

As the role of digital technologies in international trade and economy is getting increasingly more significant, Ukraine is interested in integrating into the European digital space, because the development of Ukrainian trade and economy as a whole depends on it in all areas of economic activity.

Digital development in Ukraine should be based on high-developed Ukrainian IT sector. Ukraine has high chance to repeat the success of the domestic IT sector and become at least a regional leader in complex and high-tech engineering services as programming in the field of industrial high-tech, design (electrical, mechanical, electronic, technological, construction, etc.); industrial automation and integrated engineering (including the commissioning of complex industrial sites), development and production of complex, small-scale or unique products.

More than 100 companies on the Fortune 500 list are clients of Ukrainian IT firms Cisco, IBM, Atlassian, Travelport, OpenText, Fluke Corporation, Oracle, Boeing. Jooble, DepositPhotos, Grammarly, GitLab, PetCube, Mobalytics, Preply, Attendify are only a few of the big names that got started in Ukraine. Global market leaders have already shown their interest in Ukrainian startups which lead to a number of big acquisitions. Concentrating on such areas makes the most of the existing strengths of Ukraine and preserves the engineering schools at the corporate level and the state system of technical higher education. The impact of the COVID-19 pandemic on the global economy could provide an additional incentive for companies to make greater use of digital technologies. Digital solutions can compensate the employee's remote work, their communication and team working.

4. Acknowledgements

This paper was prepared in cooperation of scientists from Kharkiv National University of Radioelectronics and Simon Kuznets Kharkiv National University of Economics, Kharkiv, Ukraine

5. References

[1] Van Ark B, Inklaar R, McGuckin R.H., Timmer M.P. The Employment Effects of the `New Economy'. A Comparison of the European Union and the United States. National Institute Economic Review 184(1) (2003) 86-98. doi:10.1177/0027950103184001008

[2] F. Biagi ICT and Productivity: A Review of the Literature. JRC Working Papers on Digital Economy, September, (2013) Joint Research Centre (Seville site)

[3] Czech Republic: "Průmysl 4.0" Digital Transformation Monitor. May, 17 URL:https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Prumysl%2040_CZ%20v1.pdf

[4] Digital Agenda of Ukraine Hi-Tech Office Ukraine, Ukrainian Institute of Future URL: https://strategy.uifuture.org/kraina-z-rozvinutoyu-cifrovoyu-ekonomikoyu.html#6-2-13

[5] Digital Economy and Society Index (DESI) 2020 – Retrieved from https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi

[6] The Global Competitiveness Report Special Edition 2020: How Countries are Performing on the Road to Recovery URL: https://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2020.pdf

[7] The Global Competitiveness Report 2019 URL:https://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf

[8] C.Foster, S. Azmeh Latecomer Economies and National Digital Policy: An Industrial Policy Perspective. The Journal of Development Studies 56:7 (2020) 1247-1262, doi: 10.1080/00220388.2019.1677886

[9] European Commission A Digital Single Market Strategy for Europe – Analysis and

Evidence. Commission Staff Working Document SWD (2015) 100. European Union. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015SC0100&from=EN
[10] European Commission Advancing Manufacturing – Advancing Europe: Report of the Task Force on Advanced Manufacturing for Clean Production, Commission Staff Working Document, SWD (2014) 120, Brussels
[11] Eurostat database (2020). - Retrived from: https://ec.europa.eu/eurostat/web/main/data/database
[12] Industry 4.0 in Europe. CBI. Ministry of Foreign Affairs, 2017, URL:https://www.cbi.eu/market-information/outsourcing-itobpo/industry-40/
[13] IT-Enterprise, SmartFactory Production Management System on FED. Association of Industrial Automation of Ukraine, URL: https://industry4-0-ukraine.com.ua/smart-factory/
[14] KOF Index of Globalization. URL: http://globalization.kof.ethz.ch
[15] Ministry of Digital transformation of Ukraine. Ukraine's integration into the EU's digital single market: Analytic report. URL: https://thedigital.gov.ua/projects/yevrointegraciya
[16] Ministry of Digital transformation of Ukraine Strategy on integration of Ukraine into the European Union Digital Single Market ("Roadmap") URL: https://thedigital.gov.ua/projects/yevrointegraciya
[17] Network Readiness Index 2020:Accelarating Digital transformation in post-COVID Global Economy URL: https://networkreadinessindex.org/wp-content/uploads/2020/11/NRI-2020-V8_28-11-2020.pdf
[18] On approval of the Concept of development of the digital economy and society of Ukraine for 2018-2020 and approval of the action plan for its implementation [Pro skhvalennia Kontseptsii rozvytku tsyfrovoi ekonomiky ta suspilstva Ukrainy na 2018-2020 roky ta zatverdzhennia planu zakhodiv shchodo yii realizatsii]: order of the Cabinet of Ministers of Ukraine URL: https://zakon.rada.gov.ua/laws/show/67-2018-%D1%80#Text
[19] On approval of the strategy for the development of high-tech industries until 2025 and approval of the Action Plan for its implementation [Pro skhvalennia Stratehii rozvytku vysokotekhnolohichnykh haluzei do 2025 roku ta zatverdzhennia planu zakhodiv shchodo yii realizatsii]: draft order of the Cabinet of Ministers of Ukraine URL: https://www.me.gov.ua/Documents/Detail?lang=uk-UA&id=c9b6f0b0-1ed5-4aba-a25e-f824405ccc64&
[20] The Readiness for the Future of Production Report 2018. Insight report. *World Economic Forum (In collaboration with A.T. Kearney)* URL: http://www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf
[21] Poland: Initiative for Polish Industry 4.0 – The Future Industry Platform. *Digital Transformation Monitor.* February, 2018. URL: https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Poland%20_vf.pdf
[22] T. Polozova, I. Kolupaieva, I. Sheiko Digital Gap in EU Countries and its Impact on Labour Productivity and Global Competitiveness, in J. Maci, P. Maresova, K. Firlej, & I. Soukal (Eds.), Hradec Economic Days, part 1, (2021) 569–570. University of Hradec Králové. https://doi.org/10.36689/uhk/hed/2021-01-065
[23] A. Verba What will happen to the Ukrainian IT market after the pandemic [Shcho bude z ukrainskym IT-rynkom pislia pandemii]. URL: https://nv.ua/biz/experts/rynok-it-karantin-i-pandemiya-koronavirusa-k-chemu-gotovitsya-tehnologicheskim-kompaniyam-novosti-ukrainy-50084249.html

Зміст

Наукове видання

«Інформаційні системи та технології» ІСТ-2021

П Р А Ц І
10-ї Міжнародної науково-технічної конференції

13-19 вересня 2021

Харків - Одеса, Україна

«INFORMATION SYSTEMS AND TECHNOLOGIES» IST-2021

Proceedings
of the 10-th International Scientific and Technical Conference

September 13-19, 2021

Kharkiv - Odesa, Ukraine

Наукові редактори: А.Д. Тевяшев, Л.Б. Петришин, В.В. Безкоровайний, В.Г. Кобзєв
Коректор – Ю.В. Міщеряков
Комп'ютерна верстка – К.Г. Онищенко, О.О. Олійник

Харківський національний університет радіоелектроніки
61166, Харків, пр. Науки, 14,
ХНУРЕ

Підписано до друку 19.09.2021.
Папір офсетний. Гранітура Times New Roman/
Умов.-друк. арк. – _____. Обл.-вид. арк. – ____.
Наклад ____. Замовлення _____

Віддруковано з готового орігінал-макета

Видавництво