

DIGITAL TRANSFORMATION AS AN ATTRACTOR OF UKRAINE'S ECONOMIC DEVELOPMENT

Nataliia Kasianova

Department of Economic Cybernetics, National Aviation University, Kyiv, Ukraine

Oleksander Kendiukhov

Department of Human Resources and Marketing, Zaporizhzhya National University,
Zaporizhzhya, Ukraine

Oleksandr Kochubei

Department of Business-Economics and Tourism, Kyiv National University of Technology
and Design, Kyiv, Ukraine

Yaroslav Oliinyk

Department of Economic and Social Geography, Taras Shevchenko National University of
Kyiv, Kyiv, Ukraine

Olena Sokhatska

Department International Economic Relations, Ternopil National Economic University,
Ternopil, Ukraine

Yuliia Zhukova

Department of Finance and Economics, Borys Grinchenko Kyiv University, Kyiv, Ukraine

ABSTRACT

The development of such a complex system as the country's economy is nonlinear and accompanied by abrupt transformations. These problems become especially relevant during the crisis. The coronavirus epidemic provoked changes in trends in the world economy, caused the beginning of the economic crisis.

Ukraine's economy was considered as a dynamic system modelled by a finite number of ordinary differential equations. Its unstable, chaotic state and potential readiness for bifurcation have been proved. To control complex systems with chaotic properties is necessary to have reliable information about the structure of their phase portrait, to determine the areas of attraction to the respective attractors. The selection of the attraction region of the attractor in the phase space allows minor changes in the initial conditions to bring the system to a qualitatively new state.

To model the behavior of the economic system from the standpoint of controlled chaos, the surface of its equilibrium is constructed, and the conditions of catastrophe are determined. The rate of change in GDP was chosen as the resulting variable of the country's economic development, and the control parameters are the residual value of fixed assets and labour costs. According to the simulation results, the equilibrium points of potential functions corresponding to the bifurcation points of the system are determined. It is proved that the economy of Ukraine is in a period of the imbalance; the country is approaching the bifurcation point. The pandemic and quarantine measures have accelerated the chaos of the country's economy and the need to choose a new attractor. The paper proposes to consider the digitalization of the economy as such an attractor.

The state of the domestic IT market is analyzed, its advantages and possible risks are determined. The sufficiency of the potential of the IT industry of Ukraine for the implementation of the strategy of the digital transformation of the economy of Ukraine, which will lead to the post-bifurcation emergence of a new trajectory of the system.

Today in Ukraine, there is no single strategy for the transition to a digital economy. There are only selected projects, solutions and technologies in the digital economy. And this multidirectional effort is the main reason for Ukraine's low performance in the digital sphere. Further development of Ukraine's economy depends on timely entry into a new trajectory. And the development of a unified strategy for the digital transformation of the economy should be the goal of cooperation between the state, science and business.

Key words: Attractor, Information Technology Market, Economic Crisis, Digital Economy, Development of Dynamic System

Cite this Article: Nataliia Kasianova, Oleksander Kendiukhov, Oleksandr Kochubei, Yaroslav Oliinyk, Olena Sokhatska and Yuliia Zhukova, Digital Transformation as an Attractor of Ukraine's Economic Development, *International Journal of Advanced Research in Engineering and Technology*, 11(7), 2020, pp. 340-349.

<http://www.iaeme.com/IJARET/issues.asp?JType=IJARET&VType=11&IType=7>

1. INTRODUCTION

The unpredictably rapid development of the digital economy has already become a significant global trend. The economy is rapidly entering the era of Industry 4.0, which involves the end-to-end digitalization of business [1-2]. Physical assets are integrated into the digital ecosystem together with the partners involved in the value chain. But what does global digitalization mean in a crisis?

The coronavirus epidemic provoked changes in trends in the world economy, caused the beginning of the economic crisis. Coronavirus and quarantine are dangerous for the world economy not only in themselves; many economists around the world are more afraid that all this will provoke a chain reaction in the world economy. Thus, back in November 2019, the IMF said that world debt reached a record \$ 188 trillion, which is 230% of GDP. A pandemic could be the trigger that will lead to the collapse of global debt. Attempts to save the situation by turning on printing presses can cause a sharp rise in inflation. The pandemic will end someday, and quarantines will stop, factories and the economy will resume their work. But the question arises as to how fast this recovery will be and what directions of economic development will be chosen.

The development of such a complex system as the country's economy is nonlinear and is accompanied by abrupt transformations, in the process of which there is chaos. The nonlinear dynamics of these processes means that the possibilities of their rational forecasting, centralized management and control are limited. At the same time, it is necessary to timely recognize the symptoms of instability and trends that dominate global trends. Also, one diagnosis of nonequilibrium states of dynamics is not enough. We must learn to influence unstable states, take into account the nonlinear dynamics of global processes. Their instability is due to several factors: geopolitical shifts, the formation of a "unipolar" world in competition with its multipolar model, the uncertainty of international financial markets, and so on.

Significant contributions to the study of new models of economies, including the digital economy, have been made by such foreign scientists as A. McAfee, E. Brynjolfsson [3], G. Westerman, D. Bonnet [4], M. Mann, A. Daly [5], N. Negroponte [6], T. Niebel [7], D. Tapscott [8], Ossik Y., Tirtó T. [1] and others. Issues related to the formation of a new economic system based on information and telecommunication technologies are actively discussed by domestic scientists: V. Lyashenko, O. Vyshnevsky [9], V. Pilinsky [10], A. Hrytsenko, Ye. Pesotska [11], V. Omelyanenko [1], Prokopenko O. [2], S. Kolyadenko [12], I. Malik [13] and others. However, the scientific substantiation of the role of digital transformation in the process of economic development of Ukraine from the standpoint of management of nonlinear economic systems has not yet been carried out.

On the way to global transformations, it is necessary to form new conditions for the functioning of the economy, to form its original structure of the economy. High-tech industries should receive a strong impetus for development. The purpose of this study is to select a model, methods and mathematical apparatus adequate to such a project, which should provide an opportunity to identify structural changes that change the dynamic properties of the economy as a system and form new proportions, new opportunities and long-term prospects for Ukraine's economy.

2. THEORETICAL AND METHODOLOGICAL MATERIALS

2.1. Ukraine's Economy in a Pandemic

Before determining the ways of development of Ukraine's economy, it is necessary to find out the depth of the crisis. In a pandemic, on the one hand, Ukraine is in a better position than many countries in the world. Thus, the average debt of a Ukrainian to banks is 5 thousand hryvnias, which is approximately equal to half the average salary per month. The average American has an average obligation to banks equivalent to almost an annual wage, and in proportions, it is more than a Ukrainian more than ten times. Therefore, a strong chain reaction in the banking sector, as in other countries, is not expected in Ukraine. The riskiest industry that can suffer the most significant losses is industry, primarily Ukrainian metallurgy. The economic crisis in the world could lead to a significant drop in demand for metallurgical products.

Ukraine may suffer significant losses from the introduction of quarantine in other countries, which will lead to a drop in incomes of migrant workers. But if the crisis lasts for six months, its impact on Ukraine's economy will not be secure, because when profits fall, the families of migrant workers will still spend money by reducing their reserves. If the crisis drags on, the problem will be more urgent, because migrant workers today are one of the largest sources of foreign exchange earnings in the country.

As for agriculture, the losses are likely to be minimal. Food prices are not expected to collapse, as they did during the 2008 crisis. During the previous global crisis, consumer

demand and money were in short supply due to deflationary contractions. Grain prices fell primarily due to higher money prices. In the current conditions, the Central Banks of the world will not allow the lack of money and are ready to turn on printing presses. On the contrary, there is a possibility that the global crisis will turn into an inflationary phase with the devaluation of money, in which case food will become more expensive.

If we summarize the possible risks of Ukraine's economy in a pandemic, we can expect:

- reduction of exports by \$ 10 billion, and, accordingly, foreign exchange earnings, which may lead to a fall in the official exchange rate to 30-35 UAH/\$;
- growth of the trade deficit to \$ 13 billion;
- the cost of external borrowing at the level of 5-8%, which will complicate debt refinancing;
- the fall in Ukraine's GDP could reach \$ 20-30 billion;
- reduction of the average salary by 20%;
- workplaces;
- return to Ukraine from 300 to 500 thousand migrant workers, which will increase unemployment and reduce remittances by at least 30% (from \$ 12 billion to \$ 8 billion).

But the economic crisis is also an opportunity. Yes, some factors can have a positive effect on Ukraine's economy. First, it is oil prices. Ukraine is an importer of fuel, and falling prices for these types of goods are a bonus for Ukraine, which can partially offset the export losses of the industry. Secondly, the global crisis in a pandemic involves the introduction of quarantine and cessation of production in countries, which could lead to the destruction of production chains around the world. Ukraine is not so dependent on this issue, as it does not produce many products of the processing industry. The cessation of production in other countries gives a chance to Ukrainian producers to conquer new markets. For example, the shutdown of pipe plants in the same China opens the way for our companies to enter this market.

As for the export of services, there are also possible losses due to lower external demand, but compared to other countries, Ukraine looks better. The IT sector in Ukraine is developing rapidly, and the crisis is not likely to lead to losses in this area. Still, it may instead stimulate growth by intensifying work on the implementation of Ukraine's digital strategy, as a factor that can increase economic productivity.

Thus, Ukraine's economy is in an extremely volatile, chaotic state and potentially ready for bifurcation. The peculiarity of deterministic chaos is that such systems, no matter how large, are elementary to control. You just have to be more discriminating with the help you render toward other people. As a result of a large number of bifurcations, which are accompanied by the emergence of new boundary cycles, there is a complex dynamic regime.

2.2. Methodology of Control of Complex Dynamic Systems

The description of dynamical systems in terms of determining the law of evolution also allows for great variety. It can be done using differential equations, discrete mappings, graph theory, Markov chain theory and other tools. The choice of one of the methods of description specifies a specific type of mathematical model of the corresponding dynamic system.

Chaos theory is a very problematic area of economic research. First, chaotic systems are almost unpredictable. From a theoretical point of view, increasing the predictability of such systems is associated with increased accuracy in measuring the initial conditions and minimizing computational errors. Secondly, based on the current economic time series, it is impossible to say with certainty that the nonlinear dependencies that are hidden in these series are chaotic. Currently, four main scenarios for the transition of dynamic systems to chaos are quite reasonable: through a cascade of bifurcations (doubling the period); due to intermittency

(discontinuity of chaotic bursts), due to quasi-periodic modes (destruction of the torus) and soliton chaos (wave excitation) [14]. In economic nonlinear dissipative systems, one can often observe a transition to chaos by doubling the period in the evolution of the order by gradually changing the control parameters.

Obviously, to control complicated systems with chaotic properties, it is necessary to have reliable information about the structure of their phase portrait. In dissipative systems, the phase portrait is divided into areas of attraction to the corresponding attractors. Therefore, for the transition of the economic system from one attractor to another, it is necessary to "translate" this point into the appropriate region of gravity. Each attractor has its region of gravity in the phase space so that you can select the boundary separating these areas. Then a rather small change in the initial conditions near the specified limit can lead to the qualitatively different behaviour of the entire nonlinear system. This means that by performing very insignificant actions concerning the system, which are consistent with its intrinsic properties, it is possible to ensure a new behaviour of the nonlinear system relating to its equilibrium position [15].

3. RESULTS AND DISCUSSION

Consider the economy of Ukraine as a dynamic system modelled by a finite number of ordinary differential equations of the form:

$$\frac{dx_i}{dt} = x'_i = f_i(x_1, x_2, \dots, x_N), i = 1, 2, \dots, N$$

If we consider the quantities x_1, x_2, \dots, x_N as the coordinates of the point x in n -dimensional space, we can obtain a clear geometric representation of the state of the system in the form of this point in the phase space of a dynamic system. The change in the state of the system over time corresponds to the movement of the phase point along the phase trajectory. In the phase space, the vector field of velocities $F(x)$, which correspond to each point x , is determined. Accordingly, the behaviour of a dynamic system can be written in the vector form $x' = F(x)$.

To model the behaviour of the economic system from the standpoint of controlled chaos is necessary to build a surface of its equilibrium and determine the conditions of catastrophe. A clear result can be obtained if you manage to select two control parameters. Thus, as the resulting variable of the country's economy (global process characteristics) we choose the rate of change in GDP, and the control parameters will be the residual value of fixed assets and labour costs (Table 1).

Table 1 Initial data for assessing the state of the national economy of Ukraine (million UAH)

Year	Gross Domestic Product	Salary Expenses	The Cost of Fixed Assets	Employment of GDP	Return on GDP
	GDP	L	K	GDP/L	GDP/K
1999	130442	32608,5	457119	4,000	0,285
2000	176128	34869,86	466448	5,051	0,378
2001	211175	47052,9	503278	4,488	0,420
2002	234138	57906,97	512235	4,043	0,457
2003	277355	71105,64	538837	3,901	0,515
2004	357544	92107,41	587453	3,882	0,609
2005	457325	137760,5	661565	3,320	0,691

2006	565018	178155,7	774503	3,171	0,730
2007	751106	234447,2	993346	3,204	0,756
2008	990819	330138,1	1251178	3,001	0,792
2009	947042	318301,2	1597416	2,975	0,593
2010	1079346	366581,6	1731296	2,944	0,623
2011	1299991	418738,0	1780059	3,105	0,730
2012	1404669	473385,4	2135987	2,967	0,658
2013	1465198	513087,0	2356962	2,856	0,622
2014	1586915	459312,2	2274922	3,455	0,698
2015	1988544	466472,4	3047839	4,263	0,652
2016	2385367	546323,4	3428908	4,366	0,696
2017	2983882	795602,5	3475242	3,750	0,859
2018	3560596	1018134,0	3783494	3,497	0,941
2019*	3974564	1004165	4268995	5,1266	0,931
2020*	4083381	1137048	4659336	3,554	0,624

* forecast built by the authors according to [16]

The equilibrium points of potential functions correspond to the bifurcation points of the economic system. According to the catastrophe theory, there is a temporary deformation of the possible function with the formation of a new equilibrium point. In our case, the potential function on the rate of return $GDP/L = F(GDP/K)$ has an equilibrium point with coordinates [0,686; 3,291] (Fig. 1).

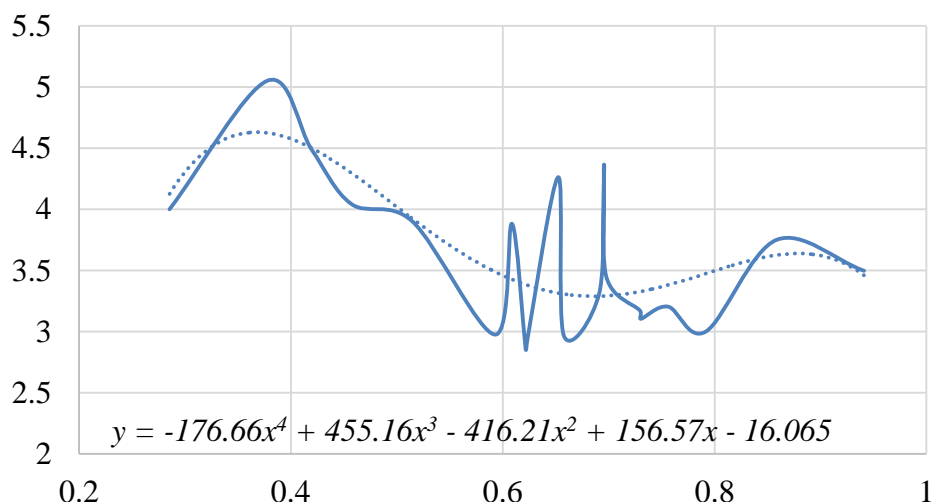


Figure 1 Graphic interpretation of the potential function of the national economy of Ukraine

Analyzing the actual value of GDP/L and GDP/K for the analyzed period, we can see that in the periods 2008-2009 and 2013-2014 the system was in a state of imbalance (potential function has reached an extremum, the phase trajectory has changed). If we draw a parallel with the actual events of these years, we can see that the periods of imbalance coincide precisely with the periods of the economic crisis in the country.

According to the results of forecasting the dynamics of indicators for 2019-2020 (Table 1), we can see that Ukraine's economy is again entering a period of imbalance and approaching the bifurcation point in 2020. The pandemic factor was not taken into account when building the mathematical model. A pandemic and quarantine measures should be seen as an external influence that pushes the economic system to choose a trajectory and move to a specific attractor. At this point, Ukraine must choose a new strategy for economic development.

The crisis and quarantine measures are forcing the role of electronic services, in particular public ones, to increase, which will increase the efficiency of all processes and, consequently, the economy as a whole. The leading role in the organization of work should be given to new technologies, algorithms, automation of production and processes, processes of virtual reality. The digital sphere can create 300-400 thousand new jobs. Cities and businesses will move to digital infrastructure and service management platforms.

Extensive Internet coverage in Ukraine allows you to expand the use of digital services in many areas. Thus, increasing the number of users from 5 million in 2016 to 15 million in 2021 will allow 95% of all stores, salons, services to make payments using cards or smartphones. This will reduce the cost of printing paper money and can help bring the economy out of the shadows. The level of corruption will be significantly reduced, as the vast majority of transactions will take place electronically and be automatically registered in several registers.

Ukraine is the leader in Europe in terms of exports of IT services – \$ 3.204 billion in 2018, which is 29% more than in the previous year. Officially, Ukraine's share in the global IT services market is only 0.5%. But the majority of Ukrainian IT companies are engaged in outsourcing and outstaffing, directly a small number of programmers carry out product development. Given the number of IT staff and the size of the ITO (Information technology outsourcing) market in 2018, according to Statista, Ukraine, in this segment occupied 7.8% of the market [17].

Revenue from the IT sector was \$ 1.578 billion, up 20% from a year earlier. Ukrainian IT startups received \$ 290 million in investments in 2018. A year earlier, this figure was \$ 265 million (44 deals). However, in 2013-2016 the industry received a total of \$ 365 million 184,500 IT professionals, and more than 4,000 technology companies – this is the state of the IT industry in Ukraine at the end of 2018 [16].

From outsourcing, Ukrainian developers are gradually moving to create their high-margin products (Fig. 2). Currently, there are 22 IT clusters in Ukraine, which unite leading companies and partners working in the field of software development and export outsourcing.

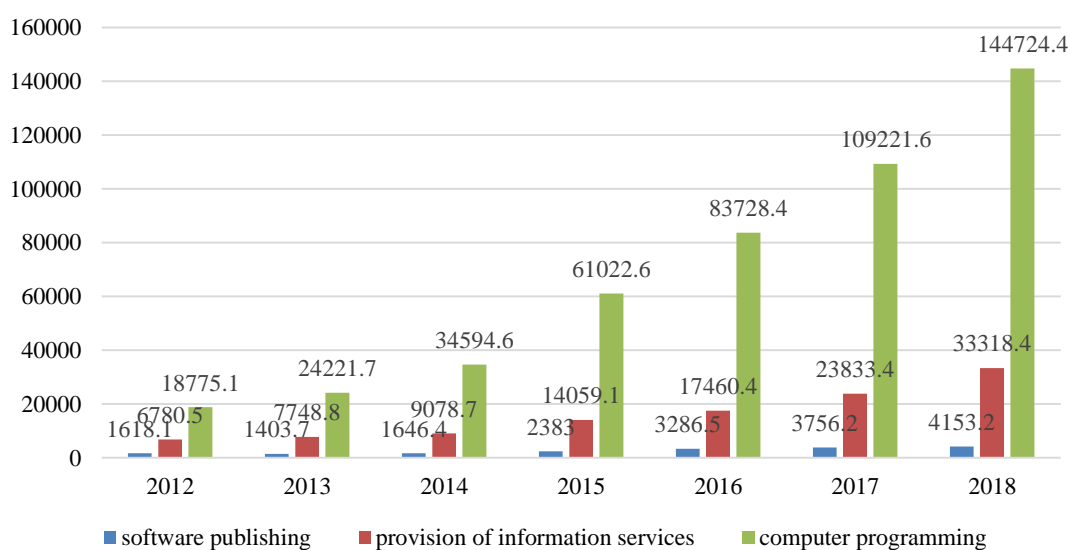


Figure 2 Dynamics of IT market development in Ukraine, UAH million (built on data [16])

Quite a large number of research and development centres of international companies are already operating in our country. Ukraine's most extensive partner is the United States (45% of companies), followed by the EU and Israel. Ukrainian R&D centres are engaged in the creation of computer games, e-commerce, work with big data and artificial intelligence, telecommunications, the Internet of Things and other no less modern areas of digital life. Among the large research, hubs are R&D centres of Ring, Snap, Plarium, Samsung, Playtika, and Wargaming companies. But only 17% of Ukrainian industries use information innovations (Table 2), while in developed countries, this figure is close to 50%.

Table 2 Dynamics of the ICT market in Ukraine

Indicator	2012	2013	2014	2015	2016	2017	2018
ICT consumption in the domestic market, \$ million	5355,43	5935,12	3636,14	3299,82	3606,79	4085,04	6236,94
ICT exports, \$ million	1113,53	1477,18	1675,55	1585,57	1644,09	1760,79	2114,96
ICT imports, \$ million	456,24	696,79	512,02	548,35	420,44	423,97	472,30
Employed in the field of ICT, thousand people	297,9	299,9	284,8	272,9	275,2	274,1	280,3
share of the total number of employees, %	1,55	1,55	1,58	1,66	1,69	1,70	1,71
Information and telecommunications, UAH million	90074,4	94278,2	105689,6	141479,6	175050,9	216803,9	273742,2
share of GDP, %	6,41	6,43	6,66	7,11	7,34	7,27	7,69

Calculated by the authors based on [16]

Market analysis shows signs of the rapid development of the Ukrainian IT industry:

- the growth rate of sales of Ukrainian IT companies exceeds the overall global rate by five times;
- the international positioning of Ukrainian IT companies is improving: attracting investments in new startups, significant M&A agreements, new contracts with global IT giants;
- the emphasis shifts from IT outsourcing to IT solutions to business problems, which leads to the involvement of business analysts in the industry;
- state international PR programs are created;
- IT companies are being integrated with Ukrainian universities, creating a demand for specialists and adjusting educational programs;
- IT clusters have been formed in 17 cities of Ukraine, which locally unite market participants [18].

At the same time, there are specific threats to the development of the IT sector in Ukraine. And this is primarily since most IT companies are not ready for faster growth due to underdeveloped management systems. Despite the large number of universities that train technicians, the shortage of highly qualified staff limits growth. There is a particular risk of losing customers due to the inability to quickly adapt to changes in technology, methodologies and new standards. In Ukraine, it is planned to limit or even ban the use of private individuals in the IT field, which will increase costs and may contribute to the outflow of highly qualified professionals abroad.

In addition to internal factors, it should be borne in mind that the global IT market is saturated with players, and competition among them is continually increasing. Yes, Indian

and Chinese companies with lower prices and more considerable resources are continually expanding their portfolio of services. In the United States, the introduction of anti-outsourcing legislation is being considered, which could lead to a significant reduction in exports of IT services [19]. European requirements for personal data protection complicate cooperation with Ukraine.

Reducing the impact of the above factors and simultaneously solving the problem of managing the development of the national economy of Ukraine, which is at a bifurcation point and must choose a new trajectory of growth, possibly due to digital transformation in the middle of the country. Building a digital economy will make the best use of the country's IT potential and counter external threats to the IT market. And the global pandemic is forcing business, education and government to move to cyberspace.

4. CONCLUSIONS

Thus, the formation of the digital economy can be considered as an attractor, the point of gravity of the trajectory of the country's economy. The strategy of the digital transformation of Ukraine's economy can be interpreted as a post-bifurcation emergence of a new trajectory of the system.

Unfortunately, today in Ukraine, there is no single image of the transition to a digital economy. And this is the main reason for Ukraine's divergent efforts and low efficiency in the digital sphere. There are individual projects, solutions and technologies, such as 4G, ProZorro, "smart cities", e-customs, e-health, e-government, etc. [22].

Thus, the development of Ukraine's economy depends on timely entry into a new trajectory. And it is the development of a unified strategy of the digital economy that should be the goal of cooperation between the state, science and business.

REFERENCES

- [1] Tirto T., Ossik Y., Omelyanenko V. (2020). ICT support for industry 4.0 innovation networks: Education and technology transfer issues, Lecture Notes in Mechanical Engineering, pp. 359-369
- [2] Prokopenko O. et al. (2020) Business process efficiency in a digital economy, International Journal of Management, 11(3), 2020, pp. 122-132.
- [3] McAfee, A., Brynjolfsson, E. (2014). The Second Machine Age: Work Progress, and Prosperity in a Time of Brilliant Technologies. New York: W. W. Norton & Company. URL: https://edisciplinas.usp.br/pluginfile.php/622156/mod_resource/content/1/Erik-Brynjolfsson-Andrew-McAfee-Jeff-Cummings-The-Second-Machine-Age.pdf
- [4] Westerman, G., Bonnet, D., McAfee, A. (2014). Leading Digital: Turning Technology into Business Transformation. Harvard Business School Publisher. URL: <https://www.vadira.de/hubfs/Blog%202019/02%20Februar/Leading-Digital-George-Westerman-Didier-Bonnet-And-Andrew-Mcafee.pdf>
- [5] Mann, M., Daly, A. (2019). (Big) Data and the North-in-South: Australia's Informational Imperialism and Digital Colonialism. / Television and New Media, Vol 20, Issue 4. <https://doi.org/10.1177/1527476418806091>
- [6] Negroponte, N. (1995). Being Digital. NY: Knopf. 256 p. URL: <http://governance40.com/wp-content/uploads/2018/12/Nicholas-Negroponte-Being-Digital-Vintage-1996.pdf>. ISBN 0340645253.

- [7] Niebel, T. (2018). "ICT and economic growth - Comparing developing, emerging and developed countries," *World Development*, Elsevier, vol. 104(C), pages 197-211. DOI: 10.1016/j.worlddev.2017.11.024
- [8] Tapscott, D. (2014). *The Digital Economy Anniversary Edition: Rethinking Promise and Peril in the Age of Networked Intelligence*. New York, N.Y.: McGraw-Hill, 2014. 448 p. ISBN: 9780071835558
- [9] Lyashenko V., Vyshnevsky O. (2018) *Digital modernization of Ukraine's economy as an opportunity for breakthrough development: a monograph*. Kyiv: Academy of Sciences of Ukraine, Institute of Industrial Economics. 252 p.
- [10] Pilinsky V., Veretyuk S. (2016) Identification of priority areas of digital economy development in Ukraine. *Scientific notes of the Ukrainian Research Institute of Communications*, № 2 (42), pp. 51-58
- [11] Hrytsenko A., Pesotska Ye. (2013) Formation of information and network economy. *Economic theory*, № 1, pp. 5-19.
- [12] Kolyadenko S. (2016) Digital economy: preconditions and stages of formation in Ukraine and the world. *Management: current issues of science and practice*, № 6, pp. 105-110.
- [13] Malik I. (2013) Trends in the development of the information economy in Ukraine. *Bulletin of the Eastern European University of Economics and Management*, Issue 1 (14), pp. 25-34.
- [14] Chernyak O., Zakharchenko P., Klebanova T. (2014) *Chaos theory in economics*, Berdyansk: Publisher Tkachuk OV, 244 p.
- [15] Kasyanova N. (2011) *Enterprise development management based on a cumulative approach: concept, models and methods*. Donetsk: National Academy of Sciences of Ukraine, Institute of Industrial Economics. SPD Kupriyanov VS. 374 p.
- [16] State Statistics Service of Ukraine. Official site. URL: <http://www.ukrstat.gov.ua/>
- [17] Statistics and market data on Technology & Telecommunications. URL: <https://www.statista.com/markets/418/technology-telecommunications/>
- [18] Development of the IT industry in Ukraine. Side view. URL: <https://kreston-gcg.com/the-development-of-the-it-industry-in-ukraine-view-from-the-outside/>
- [19] Baskakova, M., Soboleva, I. (2019). New Dimensions of Functional Illiteracy in the Digital Economy, *Educational Studies*, 1, pp. 244-263.
- [20] Order 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" of January 17, 2018 № 67-p. URL: <https://www.kmu.gov.ua/npas/proshvalennya-koncepciyi-rozvitku-cifrovoyi-ekonomiki-ta-suspilstva-ukrayini-na-20182020-roki-ta-zatverdzhennya-planu-zahodiv-shodo-yiyi-realizaciyi>
- [21] Donnelly R., Johns J. (2020). Recontextualising remote working and its HRM in the digital economy: An integrated framework for theory and practice. *The International Journal of Human Resource Management*. <https://doi.org/10.1080/09585192.2020.1737834>
- [22] Polishchuk. Y., Ivashchenko, A., Britchenko, I., Machashchik, P., Shkarlet, S. (2019). European smart specialization for Ukrainian regional development: path from creation to implementation. *Problems and Perspectives in Management*, Volume 17, Issue 2. p. 376-391. [https://doi.org/10.21511/ppm.17\(2\).2019.29](https://doi.org/10.21511/ppm.17(2).2019.29)