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ANALYSIS OF PECULIARITIES AND PROSPECTS OF DEVELOPMENT OF UKRAINE IN THE CONCEPT OF «INDUSTRY 4.0»

Об'єктом дослідження є процес формування та особливості застосування концепції «Індустрія 4.0» як невід'ємної складової сучасного економічного світогляду в Україні. Але застосовуючи концепцію «Індустрія 4.0», потрібно оцінювати можливі негативні соціальні наслідки нового витка технічного прогресу. Тому дане дослідження направлене на оцінювання наявних проблем, аналіз особливостей та перспектив України в застосуванні концепції «Індустрія 4.0».

В роботі застосовувалися методи теоретичного узагальнення, метод структурно-функціонального аналізу, діалектичний та системно-аналітичний методи. Діалектичний метод дозволив проаналізувати та узагальнити певні аспекти наукових знань та поглядів на природу концепції «Індустрія 4.0». Системно-аналітичний метод дозволив дослідити функціонування і розвиток концепції «Індустрія 4.0» як фактору соціально-економічного розвитку країни.

Концепція «Індустрія 4.0» розглядається як концепція «виробництва знань». Все більш затребуваними стають висока кваліфікація і відповідний їй рівень знань. У порівнянні з іншими європейськими країнами, Україна відстає за всіма показниками, окрім охоплення населення вищою освітою. Україна як і раніше займає досить високі позиції за показниками «вища, середня і професійна освіта» та «ємність ринку», однак має критичне відставання в рейтингах «макроекономічного середовища», «інституцій», «розвитку бізнесу». Україна за Глобальним інноваційним індексом демонструє високий потенціал для інноваційної моделі розвитку економіки країни в цілому. Тому впровадження концепції Індустрія 4.0 і цифровізація економіки призведе до зміни системи виробництва і реалізації продукції, буде сприяти організаційній та структурній трансформації, появи нових моделей ведення бізнесу із застосуванням нових технологій.

Науково-технічна революція, впровадження нових технологій, стрімка зміна потреб суспільства і бізнесу, поява нових форм взаємодії та дифузії знань – невід'ємні складові сучасного постіндустріального світу. Цифровізація породжує додаткові конкурентні можливості, реалізація та розвиток яких, дозволить збільшити ефективність суспільного виробництва і підвищити якість життя населення країни.

Ключові слова: нова стратегія економічного розвитку, четверта промислова революція, концепції «Індустрія 4.0», цифрова економіка.

1. Introduction

The world entered an era of global change. The main spheres of human life – economics and management, science, security – will soon receive a new form and content. The deep penetration of digital technologies into our lives is one of the characteristic features of our present and future. This process is objective, inevitable and impossible to stop.

Accelerated development and the emergence of new technologies leads to the formation of innovative concepts of economic development, which ensure that the industry's capabilities match the growing and constantly changing needs of society. The need for flexible adaptation to the environment requires the maximum possible reduction of the time for the implementation of operations and, therefore, overcoming the gaps between the current state of industry and digital production. Revolutionary innovations and exponentially increasing digitalization of processes are actively changing business models of modern enterprises. Today, for the description of the directions of development, the following terms are used, such as

Industry 4.0, digital economy, «smart» economy, Internet stuff, cyber-physics systems, supercomputers, digital transformation, digital society, «smart» cities and more. The digital economy defines a completely new stage of development, which provides a transition to a knowledge economy in which the human capital is the main factor of development (knowledge, skills, abilities and capabilities of labor resources).

The Hannover Fair in 2011, presented by the German Government's «Industry 4.0» program, marked the beginning of an innovative economic arms race. Programs similar to «Industry 4.0» were adopted in the Netherlands, France, Great Britain, Italy, Belgium and other countries [1]. In the United States, from 2012, there is also a non-profit Coalition of leaders of intelligent production, which, in addition to business representatives, includes state institutions, universities and laboratories.

Digitalization of the economy is realized through the development and introduction of innovative digital technologies on a permanent basis, as well as the formation of appropriate legal, socio-economic, organizational and other

conditions for the transformation of society and economy to a new level of development. So, understanding the possibilities and threats of the «Industry 4.0» concept in Ukrainian realities can be an important step in reforming the economic development strategy of the country.

However, it should be emphasized that the main problem of Ukraine's accession to the fourth industrial revolution is that the concept «Industry 4.0», which combines advanced development into a single system, is a new phenomenon for the country's economy. Particular attention should be paid to the gap (challenges) between the current state of the economy and industry of Ukraine and the target level of development, which ensures the formation of the digital economy and Industry 4.0 at the macro level.

In addition, the significant obstacle to the formation of the digital economy can be called the lack of awareness of business entities about the concept and technology of Industry 4.0, the benefits and complexity of its implementation. Moreover, the process of development and implementation of digital technologies requires significant investment, but in Ukrainian realities is a serious problem for the economy. Because financing should be organized in several directions: development of infrastructure for the digital economy, formation of the regulatory framework, support for innovation and training for the digital economy.

The formation of the digital economy is a matter of national security and independence of Ukraine, the competitiveness of domestic enterprises, the position of the country on the world stage. So, it is very important that the result of the implementation of the concept «Industry 4.0» will be the emergence of various initiatives and projects on digitalisation at all levels: from national to individual enterprises. In the event of the transformation of such projects into a mass phenomenon, there is a hope that the number of technological changes will change the quality of life, management systems, business models, relations between people. Only such complex changes will ensure the transformation of the Ukrainian economy into a digital one.

2. The object of research and its technological audit

The object of the research is the process of formation and application of the concept «Industry 4.0» in Ukraine.

In order to effectively form a new socio-economic development strategy of Ukraine, the features of the concept of «Industry 4.0» as an integral part of modern economic outlook were studied. Characteristic features of «Industry 4.0»: interoperability (compatibility), virtualization, decentralization and work in real time. Cyber physical systems, cloud computing and big data technologies, the Internet of things are becoming more popular in business, along with vertical and horizontal integration, virtualization and digitalization of the whole process of creation of value chain. Many developed countries and business giants are active participants in the Fourth Industrial Revolution: state programs, commercial associations and non-profit organizations are set up, aimed at eliminating barriers to the application of the Industry 4.0 concept. But in their quest for «large-scale» digitization of the economy, both corporations and states risk undervaluing possible negative social consequences of a new round of

technical progress. Digitization generates opportunities that can have both unexpected threats and new good.

Despite the seriousness of potential social risks that are implicit in the application of the Industry 4.0 concept, it promises such rosy economic prospects that many countries have recognized the Laissez-faire principle as the best choice to avoid creating any bureaucratic obstacles to potential profits. Unfortunately, most experts are not inclined to evaluate the prospects of Ukraine in this race optimistic. So, to identify existing problems and opportunities of Ukraine in the application of the concept of «Industry 4.0» and coordinated work of state and society is an important task today.

3. The aim and objectives of research

The aim of the research is to determine the peculiarities and elaborate prospects of using the concept «Industry 4.0» under Ukrainian realities.

To achieve the aim, the following scientific tasks must be performed:

1. To research the peculiarities of the formation and application of the concept «Industry 4.0».
2. Analyze analytical reports on the practical application of the concept «Industry 4.0».
3. To identify the prospects of applying the concept «Industry 4.0» in the context of implementing a new strategy of socio-economic development of the country.

4. Research of existing solutions of the problem

Concept Industry 4.0 was first introduced in Germany in 2011 and marks the initiation of the fourth industrial revolution [2]. The digital economy and Industry 4.0 are of great interest among scientists and practitioners. The description of these concepts is devoted to the work of many famous scientists and practitioners. In [3], the research of the concept-categorical apparatus of production is carried out, which corresponds to the concept of Industry 4.0. And in [2] interesting research results of the industry 4.0 on the logistic chains, systems of production and sales of products are presented. The publications [4–6] form the basis for building a digital economy, defining the essence, features and problems of its development. The authors of papers [7, 8] determine the significance and benefits of the development of the digital economy, as well as the possibility of efficient use of new technologies for processing and storing data, building smart cities, automating production, and so on. The possibilities and directions of business transformation and the economy as a whole are actively explored to ensure functionality and competitiveness in the new «digital» business environment. The increased interest in this context is directly caused by the model and mechanism of the construction of the digital economy, the determination of its components, the identification of the main trends and complexities of development in Ukraine and in the world. The need for accelerated adaptation of strategic management of organizations to new technologies, resources and concepts of business development is growing.

The leading consulting company McKinsey (Chicago, Illinois, USA) summed up the main driving forces behind creating value and enjoying economic benefits within its

digital compass, which identified eight values (calling them drivers). These drivers will create value for companies and customers at every step. Using these values (drivers), you can describe the economic benefits for companies in the concept of «Industry 4.0» in more detail. These values (drivers) explain how they affect the performance of companies related to the Industry 4.0 concept, the ultimate goal of which is to maximize company value [9].

The concept of «Industry 4.0» is characterized by the increasing level of digitalisation and interconnection products, business models and value chains. Successful implementation of digital manufacturing decisions entails a digital connection throughout the value chain – this continuous data stream is also called «digital thread» [10]. Customers will be centered around the chain of value added products and services [11].

The concept «Industry 4.0» with the exchange of information, the internal and external boundaries of which merge, therefore, the classical boundaries of individual enterprises will be shifted [12].

The Industry 4.0 concept digitizes and integrates processes vertically across the organization through all functions, from product development/acquisition through manufacturing, DIEM logistics and after-sales services [10]. Vertical integration defines intellectual association and digitalization at different hierarchical levels of the value chain. This will allow the use of process digitization of the order and the product, taking into account the specifics of the client, when automatic data transmission in integrated planning and production system can be guaranteed [13, 14].

Within this vertical integration, flexible and reconfigurable production structures can be made that can be adapted to each specific customer order and market changes. These functions are key tools for manufacturers to remain competitive in markets [14].

The digitalization of the horizontal chain of value creation combines and optimizes the flow of information and flow of goods from the client throughout the corporation to the supplier level and vice versa. In this approach, all internal mechanisms (eg, purchasing, production, logistics) will be interconnected with all external partners [13].

In the horizontal integration, the concept «Industry 4.0» will allow all business entities to constantly adapt to new circumstances, for example, to the volume of order or availability of materials. So, automatic optimization of production processes becomes possible through the integration of suppliers and customers in the value chain [15].

Thus, the digital economy in the context of the concept «Industry 4.0» can be viewed from different points of view. The digital economy is:

- the type of economy, characterized by active implementation and practical use of digital technologies for collecting, storing, processing, conversion and transmission of information in all areas of human activity;
- a system of socio-economic, organizational and technical relations, based on the use of digital information and telecommunication technologies;
- complex organizational and technical system in the form of a set of different elements (technical, infrastructure, organizational, software, normative, legislative, etc.) with distributed interaction and mutual use of economic agents for the exchange of knowledge in conditions of permanent development.

5. Research methods

To solve the problems, the following methods were used:

- a dialectical method, due to the need to analyze and generalize certain aspects of scientific knowledge, which analyze the evolution of scientific views on the nature of the concept «Industry 4.0»;

- structural-functional analysis of the principle of systematic study of economic phenomena and processes;
- a system-analytical method, according to which, the study of the functioning and development of the concept «Industry 4.0» is considered as a factor of socio-economic development of the country.

6. Results of research

The evolution of the industry illustrates that since 1750 industry has been actively developing, starting with the creation of large factories within the Industry 1.0 industry. The invention of electricity allowed to achieve current production (Industry 2.0), the leap of information technology development led to the development of automation of production (Industry 3.0). Finally, the integration of digital and physical systems should ensure the implementation of the industry paradigm 4.0, the essence of which is the autonomous implementation of production processes. Achievement of this level of development is possible in the long-term perspective and requires the transformation of all components involved in business processes: enterprises, products, information, personnel, consumers, equipment, transport, etc. [16].

The concept «Industry 4.0» implies the implementation of processes for the development, production and delivery of products through real-time data transmission between all participants in business processes, with a view to maximizing transparency and awareness. At the same time, companies are able to track the location and condition of goods at any time, to adjust the equipment autonomously, adapting the materials to the production conditions used («automatic» product customization). Management Concept «Industry 4.0» uses innovative methods and prediction models through intelligent processing «big data» based on early warning algorithms, support management decisions, mental maps and more.

In the next twenty years, automation of the industry will reduce about 40 % of jobs; in the first place low-paid positions in the production are subject to reduction. Over the past 30 years, human participation in manufacturing worldwide has declined from 64 to 59 %. The concept «Industry 4.0» can be considered as the concept of «production of knowledge». So, it is worth highlighting the features of such «production»:

- knowledge is made up of a larger share of the value of goods and services. It is known, for example, that about 70 % of the cost of a modern car is the design, electronics and other intelligent components. For such products as software, the «degree of engagement» of knowledge in creating their value is even higher;
- the activity on creation, storage and use of knowledge is becoming more and more popular, the importance of the education system is changing. Investments in education are considered as investments in human capital;
- the rate of aging of knowledge increases significantly. By the time the diploma is awarded, most of

the professional knowledge of the professional cycle (especially in the field of innovative technologies) becomes irrelevant. This leads to the need to continue the learning process throughout the working life of a person;

- in the structure of the population, the share of workers, employed in the production, storage, transportation and use of knowledge is increasing, intensifying competition among them. More and more in demand are the high qualifications and the level of knowledge corresponding to it. Skilled workers provide added value to the product, thanks to the knowledge they own and use;

- the excessive specialization in production is reduced. The need for personification is growing. These trends place high demands on the level of professionalism of labor resources [17].

In 2016, according to the Innovation Index of the European Innovation Scoreboard, Ukraine became a member of the «slow innovators» group. In comparison with other European countries, Ukraine lags behind all indicators, except for the coverage of the population with higher education.

According to the data of 2017, Ukraine was on the 50th place in 127 countries according to the Global Innovation Index, which demonstrates the high potential for an innovative model of economic development of the country as a whole. At the same time, the quality of public institutions in the context of innovation is rather low (96 out of 120 according to the «efficiency of government»).

According to the index of innovation development of the agency Bloomberg in 2018, Ukraine lost 4 positions during the year, which corresponds to 46th place in the ranking of 50 countries. Ukraine was the worst in terms of labor productivity (50th place) and got 48th place for technological opportunities. At the same time, it was possible to get 21 place on the efficiency of higher education and 27 place on patent activity.

In the Global Competitiveness Index, calculated for 2017–2018, Ukraine ranked 81st out of 137 countries under study. Ukraine still has a very high position in terms of «higher, secondary and vocational education» and «capacity market», but has a critical lag in ratings of «macroeconomic environment», «state institution», «business development». Ukraine undertook the «innovation» subindex in this year's 61st position, which shows a fall of 9 points compared to 2016–2017.

According to the order of the Cabinet of Ministers of Ukraine No. 680-r dated June 17, 2009, the national innovation system is a set of legislative, structural and functional components (institutions). Institutions are involved in the process of creating and applying scientific knowledge and technologies and determine the legal, economic, organizational and social conditions for ensuring the innovation process [18].

Already, one can predict that the main consequence of a new technological wave will be that the cost of labor will cease to be decisive when generating production costs. This means that the low-skilled labor force, due to which developing countries and some sectors of the Ukrainian economy live, will cease to be significant. And the main factor will be the technological potential.

The main concern with the application of the concept of «Industry 4.0» is that a significant expansion of possible operations will not necessarily lead to new job creation

for people, which in turn may become a socio-economic problem for the country. Researchers believe that by the year 2020, robots and new technologies can leave five million people in the world without the work. The largest reductions are forecasted among office and administrative workers.

It is vitally important for Ukraine to maintain national competitiveness. Today, Parliament discusses the establishment of the Law «On the national innovation system». It is necessary to reconfigure the whole system of economy – from the venture stage, including the National Academy of Sciences of Ukraine, university science, production. All this should be redefined in an innovative way.

In addition, a program of scientific and technological progress and its socio-economic consequences should be developed. Such a program will give an idea of the consequences of the fourth technological revolution [19]. For example, the consequences of which will be the disappearance of the profession of accountant (and this is already happening), which will lead to a reduction in the driver's profession in the near future, and so on.

In this regard, the government of the country should already foresee substantial expenditures on the establishment of a system of retraining in the budget, so that people who are released from the traditional sectors of the economy find themselves adequately applied.

7. SWOT analysis of research results

Strengths. Increase of labor productivity by 15–25 % without material costs; by 5–8 %, including the cost of materials (the greatest benefits are expected in industry and mechanical engineering). Greater profitability, reduced production costs, reduced production cycle, increased shareholder value at enterprises. A new type of intellectual, flexible value chain, the production of individual goods, decentralization of decision making.

Weaknesses. Employment: This is a controversial area, since automation and technological advances in some cases can lead to a reduction in employment, in particular in the short term. Over the next 10 years, the Boston Consulting Group expects an increase in employment by 6 %. The Boston Consulting Group warns of the need to have a variety of skills and the replacement of low-skilled workers by machines, while engineers, software developers and IT professionals will be in high demand [20]. Insufficient development of the system of public-private partnerships in the implementation of innovation projects - the share of enterprises receiving funding from the budget for these purposes is 0.8 % (in Germany – 8.8 %, in Belgium – 12.7 %) [21].

A number of factors influence these predictions:

- technological standards, labor supply with relevant skills, investments and research;
- significant cost of developing and implementing technologies;
- the increased complexity of decision-making (decision-making processes are complicated as a result of a huge number of alternatives and multiple contradictory goals).

Opportunities. The perspectives of the object of the study include:

- the possibility of developing new leading and revolutionary markets for goods and services;

- improved customer satisfaction with new markets; improved product quality and product diversity;
- the possibility of transition to the sixth technological structure of the economy;
- the possibility of strengthening cooperation between industrial enterprises and research organizations in the process of achieving synergy;
- an opportunity to increase GDP growth rate – about 3 % of GDP per year (this indicator depends on the expected increase in demand from manufacturers for improved equipment and the use of data in combination with consumer demand for some products).

Threats. The threats of the object of the study include:

- the threat of weakening the competitiveness of various industries in Ukraine in comparison with world leaders;
- threat of weakening of economic safety of industrial enterprises;
- weakening of the competitiveness of enterprises in the regions of Ukraine;
- insufficient level of formation of the ecosystem of the concept «Industry 4.0» in Ukraine, including: difficulties with the development of applied services and organizational readiness of potential clients and developers of applications for industrial Internet platforms [22];
- threat of the fundamental impossibility of Ukrainian enterprises to compete with leading international industrial corporations [22];
- non-investment character of the taxation system;
- lack of long-term financing;
- high interest rates on long-term loans.

8. Conclusions

1. It has been determined that knowledge constitutes an increasing share of the value of goods and services; the activity on creation, storage and use of knowledge becomes more and more in demand, the role of the education system is changing. Investments in education are considered as investments in human capital. The rate of aging of knowledge is significantly increasing. The structure of the population increases the share of workers employed in the production, storage, transportation and use of knowledge, increasingly competition among them. Reduced excessive specialization in production. The need for personification is growing. These trends place high demands on the level of professionalism of labor resources.

2. It is noted that each analytical report on the practical application of the concept «Industry 4.0» mentions examples and cases of new technologies, which states that technology 4.0 is not just new technologies or the evolution of the old ones. These are new approaches and new visions to how to produce products, how to manage assets and how to do business altogether. Many companies are just beginning to understand this, and it's not easy for many industrial and service-oriented sectors.

3. It was found that the main consequence of the new technological wave will be the change in the specific weights of the components of the cost of products. Thus, the cost of labor will cease to be determinative when generating production costs. This means that the low-skilled labor force, which is crucial for developing countries, in particular, for the Ukrainian economy, will no longer be a significant factor in the formation of value. And the main factor will be the technological potential.

In addition, it was emphasized the need for Ukraine to maintain national competitiveness through the adoption of the Law «On the National Innovation System».

Thus, the main advantages of digitization Ukrainian economy may be:

- high speed and pace of development;
- transformation of business processes of enterprises and industries;
- reduction of expenses for realization of business processes;
- the emergence of new business models;
- the emergence of new «smart» products, new markets;
- changes in the structure of the required professions;
- constant diffusion of innovations;
- active development of electronic payment systems.

Thus, digitization of the Ukrainian economy implies the formation of significant objective competitive advantages for enterprises in the future, provided that they overcome a number of barriers that are being observed today. This determines the need to develop roadmaps for the implementation of the Industry 4.0 concept, «smart» mechanisms for transforming existing industrial systems, models and mental maps for building a digital economy.

References

1. Pas'ko I. Chto nuzhno znat' ob Industrii 4.0 i Internetе veshhey // theRunet. 2015. URL: <http://therunet.com/articles/4826> (Last accessed: 11.03.2018)
2. Pfohl H., Yahsi B., Kurnaz T. The impact of Industry 4.0 on the supply chain: proceedings // HICLConference PROCEEDINGS. 2015. P. 31–58.
3. Qin J., Liu Y., Grosvenor R. A Categorical Framework of Manufacturing for Industry 4.0 and Beyond // Procedia CIRP. 2016. Vol. 52. P. 173–178. doi: <http://doi.org/10.1016/j.procir.2016.08.005>
4. Formation of digital economy in russia: essence, features, technical normalization, development problems / Babkin A. V. et. al. // Nauchno-tehnicheskie vedomosti SPbGPU. Ekonomicheskie nauki. 2017. Vol. 3. P. 9–25
5. Babkin A. V. Promyshlennaya politika v tsifrovoy ekonomike: problemy i perspektivy: proceedings. Saint Petersburg: Politekhn. un-t, 2017. 699 p.
6. Babakin A. V. Tsifrovaya ekonomika i «Industriya 4.0»: problemy i perspektivy: proceedings / ed. by Babakin A. V. Saint Petersburg, 2017. 685 p. doi: <http://doi.org/10.18720/IEP/2017.1>
7. Tsifrovaya ekonomika – razlichnye puti k effektivnomu primeniyu tekhnologiy (BIM, PLM, CAD, IOT, Smart City, BIG DATA i drugie) / Dobryinin A. P. et. al. // International Journal of Open Information Technologies. 2016. Vol. 4, Issue 1. P. 4–11.
8. Tsifrovaya ekonomika – «umnyy sposob rabotat'» / Kupriyanovskiy V. P. et. al. // International Journal of Open Information Technologies. 2016. Vol. 4, Issue 2. P. 26–33.
9. Industry 4.0 – How to Navigate Digitization of the Manufacturing Sector // McKinsey, 2015. P. 22–50.
10. Nanry J., Narayanan S., Rassej, L. Digitizing the Value Chain. 2015. URL: <https://www.mckinsey.com/business-functions/operations/our-insights/digitizing-the-value-chain>
11. Geissbauer R., Vedso J., Schrauf S. Industry 4.0: Building the Digital Enterprise. PWC. 2016. P. 6–27. URL: <https://www.pwc.com/gx/en/industries/industries-4-0/landing-page/industry-4-0-building-your-digital-enterprise-april-2016.pdf> (Last accessed: 11.03.2018)
12. Wischmann D. S., Wangler D. L., Botthof A. Industrie 4.0 – Volksund betriebswirtschaftliche Faktoren für den Standort Deutschland. Eine Studie im Rahmen der Begleitforschung zum Technologieprogramm AUTONOMIK für Industrie 4.0. Berlin, 2015. 56 p. URL: <https://vdivde-it.de/system/files/pdfs/industrie-4-0-volks-und-betriebswirtschaftliche-faktoren-fuer-den-standort-deutschland.pdf> (Last accessed: 11.03.2018)

13. Chancen und Herausforderungen der vierten industriellen Revolution. PWC. 2014. P. 3–37. URL: <http://www.strategyand.pwc.com/media/file/Industrie-4-0.pdf> (Last accessed: 11.03.2018)
14. Stock T., Seliger G. Opportunities of Sustainable Manufacturing in Industry 4.0. *Procedia CIRP*. 2016. Vol. 40. P. 536–541. doi: <http://doi.org/10.1016/j.procir.2016.01.129>
15. Lichtblau D. K. et. al. *Industry 4.0. Readiness*, 2014. 76 p.
16. Andriushchenko K. Formation of conceptual approaches to management of intellectual capital of knowledge considering hierarchical levels at the enterprise. *International Journal of Critical Accounting*. 2016. Vol. 8, Issue 5/6. P. 379–395. doi: <http://doi.org/10.1504/ijca.2016.10002493>
17. Andriushchenko K. The formation of the system of intellectual capital management at enterprises. *Technology Audit and Production Reserves*. 2017. Vol. 2, Issue 4 (34). P. 4–9. doi: <http://doi.org/10.15587/2312-8372.2017.98178>
18. Pro rekomendatsii parlamentskykh slukhan na temu: «Natsionalna innovatsiina systema: stan ta zakonodavche zabezpechennia rozvytku»: Postanova Verkhovnoi Rady Ukrainy. 06.07.2018. No. 8571. URL: http://search.ligazakon.ua/l_doc2.nsf/link1/DH6M300A.html (Last accessed: 11.03.2018)
19. Andriushchenko K. State-private partnership as a factor of development of transport communications maritime industry. *Stredoevropsky vestnik pro vedu a vyzkum*. 2014. Issue 2 (21). P. 43–48.
20. Industry 4.0: The future of productivity and growth in manufacturing industries / Russman M. et. al. The Boston Consulting Group, 2015. URL: <http://www.zvw.de/media/media.72e472fb-1698-4a15-8858-344351c8902f.original.pdf> (Last accessed: 11.03.2018)
21. Industry 4.0 / Smit J. et. al. European Parliament, 2016. P. 1–94. URL: [http://www.europarl.europa.eu/RegData/etudes/STUD/2016/570007/IPOL_STU\(2016\)570007_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2016/570007/IPOL_STU(2016)570007_EN.pdf) (Last accessed: 11.03.2018)
22. 2016 Industrial Internet of Things, *Industrie 4.0 Study // Control Engineering*. URL: <https://www.controleng.com/single-article/2016-industrial-internet-of-things-industrie-40-study/25fc285474eeebaf583ea942849a1872.html> (Last accessed: 11.03.2018)

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