

THEORETICAL AND APPLIED ASPECTS OF ECONOMIC PROCESSES IN UKRAINE AND IN THE WORLD ECONOMY

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ANALYSIS OF THE INTERNET OF THINGS MARKET: INTERNATIONAL AND NATIONAL CONTEXT

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Internet of things (IoT), digital economy, communications, innovations, Internet, information and communication technologies (ICT).

In the conditions of forming a digital society, ensuring sustainable development and overcoming the consequences of the COVID-19 pandemic, enterprises in various sectors of the economy face the question of reformatting their activities taking into account the impact of the latest technologies. The need to completely change the approach to life and work provided an opportunity to rebuild the economy, balance differences and make significant changes in various areas. During this period, the expansion and development of information and communication technologies became important. Digital connections, services, and tools have brought about significant changes in everyday life, allowing people to work, study, stay in touch with friends and family, receive medical care from afar, and more. At the same time, enterprises were given the opportunity to optimize production, update equipment and reduce costs.

Digitization is a recognized mechanism for achieving economic growth through the positive impact of technology on the efficiency, effectiveness, cost and quality of economic, social and personal activities. In particular, Internet of Things technologies are increasingly used at the local level and are an important component of the development of smart cities. The Internet of Things combines the physical and virtual worlds, contributing to the creation of intelligent environments.

The article establishes that the Internet of Things is a concept of communication of objects that use technologies to interact with each other and with the environment. The foreign and national experience of market development and the spread of the Internet of Things is analyzed, as well as statistical data on the prospects for the use of the technology are provided. A number of main advantages created by IoT and examples of successful world practice of its application are identified.

АНАЛІЗ РИНКУ ІНТЕРНЕТ РЕЧЕЙ: МІЖНАРОДНИЙ ТА НАЦІОНАЛЬНИЙ КОНТЕКСТ

Венгерська Н.С., Ворона Р.А.*Запорізький національний університет**Україна, 69600, м. Запоріжжя, вул. Жуковського, 66***Ключові слова:**

Інтернет речей (ІР), цифрова економіка, комунікації, інновації, Інтернет, інформаційно-комунікаційні технології (ІКТ).

В умовах формування цифрового суспільства, забезпечення сталого розвитку та подолання наслідків пандемії COVID-19 перед підприємствами різних галузей економіки постає питання переформатування їх діяльності з урахуванням впливу новітніх технологій. Необхідність повністю змінити підхід до життя та роботи надала можливість перебудувати економіку, врівноважити розбіжності та зробити суттєві зміни у різних сферах. У цей період важливим стало розширення та розвиток інформаційно-комунікаційних технологій. Цифрові зв'язки, послуги та інструменти викликали значні зміни у повсякденному житті, дозволивши людям працювати, навчатися, підтримувати зв'язок з друзями та родиною, отримувати медичну допомогу здалеку тощо. Водночас підприємства отримали можливість оптимізувати виробництво, оновити обладнання та зменшити витрати.

Цифровізація являє собою визнаний механізм для досягнення економічного зростання шляхом позитивного впливу технологій на ефективність, результативність, вартість та якість економічної, громадської та особистої діяльності. Зокрема, технології Інтернету речей (IP) все більше використовуються на місцевому рівні і є важливою складовою розвитку розумних міст. Інтернет речей поєднує фізичний та віртуальний світи, сприяючи створенню інтелектуальних середовищ.

У статті встановлено, що Інтернет речей є концепцією комунікації об'єктів, які використовують технології для взаємодії між собою та з навколишнім середовищем. Проаналізовано зарубіжний та національний досвід розвитку ринку та поширення Інтернету речей, а також наведено статистичні дані щодо перспектив використання технології. Визначено низку основних переваг, створюваних IoT, та приклади успішної світової практики її застосування.

Statement of the problem

Given the rapid development of information technologies, the use of intelligent devices and the Internet of Things is becoming especially important. In a world where information systems are increasingly globalized, it is clear that without Internet-connected devices it is simply impossible to imagine the future of life. In general, one of the main trends in the development of information systems and technologies is the spread of access to computing resources of networks for individual users.

It is worth noting that the Internet of Things is a digital revolution, to some extent even greater than the industrial revolution. This concept is one of the most visible manifestations of the Fourth Industrial Revolution that we are currently experiencing. As in past periods, early adopters and professionals who can solve problems and adapt to new technologies will be able to ensure their competitiveness for decades to come.

Internet of Things devices are necessary not only for everyday use, but also in the modern business environment, where they are actively spreading in various industries and fields, thanks to which they have become an integral part of our lives.

Analysis of recent studies and publications

The development of the digital economy, modern trends and prospects of smart industry and problems on the way to the development of Internet services are considered in the works of such scientists as: E. Tofler, K. Schwab, P. Fries, M. Harrison, O. Gudz, V. Lyashenko [1], A. Sagalovych, V. Tyshchenko, V. Vishnevskiy. Research into the implementation and development of the Internet of Things was carried out by such scientists as B. Zhurakovskiy [2], I. Zeniv, A. Parkhomenko, A. Kruts [3], V. Glushkov, I. Shevchuk. Coverage of the prospects for the development of the Internet of Things market was revealed in the works of S. Gringard, C. Benson, J. Lee, R. Phal, H. Paramonov, A. Nakonechny, and Z. Veres [4]. However, the issues of comparative analysis of the international and national market of the Internet of Things have not yet been considered sufficiently, therefore the topic of the article is relevant.

Objectives of the article

The purpose of the article is to conduct a comparative analysis of the development of the Internet of Things

market and its impact on economic processes in international and national contexts.

The main material of the research

Modern global and national companies face the need to adapt to new technological innovations. New technologies are emerging that affect both intelligent products and services available to society, as well as the production of goods and the provision of services. This involves changing production and management systems. The world is in the era of the Fourth Industrial Revolution [5].

Nowadays, there is a combination of digital, physical and biological technologies. Humanity is at the beginning of a new revolution, and therefore significant transformations are expected that will fundamentally change life, work, and communication. Radical changes are taking place in all fields, the destruction of established norms and connections, while evolutionary procedures for their renewal are not offered.

Recently, the term “digitalization” has been widely used, which means the saturation of the physical world with electronic-digital devices, means, systems and the establishment of electronic-communication exchange between them, which actually enables the integral interaction of the virtual and the physical, that is, creates a cyber-physical space [6]. The main goal of digitization is to achieve the digital transformation of existing and create new sectors of the economy, as well as the transformation of spheres of life into new, more efficient and modern ones.

In 1999, Kevin Ashton coined the term “Internet of Things” (IR) to reflect the capabilities of radio frequency identification used in corporate supply systems to count and track goods without the need for human intervention [7]. The IoT ecosystem consists of a variety of Internet-enabled devices. They are equipped with built-in processors, sensors and communication equipment to collect, transmit and process data received in their environment.

“Internet of things” is a network that allows the devices we use every day to interact with each other [8]. Things “communicate” with each other, exchanging data. Also, this concept involves devices performing certain actions without human intervention. Thus, the Internet of Things (IR) (English – IoT) is a system of interconnected computing devices, mechanical and digital machines, objects, animals or people, which are provided with unique identifiers and the ability to transmit data over the network without

requiring of a person to the interaction of a person or a person with a computer [9].

According to the American investment bank Goldman Sachs, in 2016 the number of connected devices in the world in IR reached 12 billion. Analysts of IoT Analytics predict that this figure will grow to 27 billion by 2025 [10]. At the beginning of 2021, the IoT market was estimated to be around \$300 billion.

In the early days of IoT adoption, the solutions were most interesting for business and industry, in particular for machine communication. But now “smart” devices are increasingly penetrating households and offices to be available to all users. So where is the Internet of Things being used? Let’s consider several examples.

Smart homes provide automatic control of home technologies such as temperature control, lighting, entertainment systems, home appliances and alarms. In the West, “smart” music speakers, thermostats, refrigerators, televisions, sockets and even light bulbs have become commonplace and can be programmed and controlled using special software.

Medical IoT (MIoT) helps monitor health. With its help, doctors can monitor patients, or people themselves can monitor their physical condition. Components of MIoT are fitness bracelets, cuffs for measuring blood pressure and heart rate, as well as glucometers.

In “smart” cities, data collected by a complex of sensors is used to improve infrastructure, utilities and other services. Cameras, lights, electricity meters, air quality monitoring systems and other devices are connected to the Internet.

Modern cars and other vehicles can be connected to the Internet in order to provide access to control and receive data.

The use of Internet of Things (IoT) technologies in “smart” warehouses helps to improve production and business efficiency by using robots, drones, scanners, RFID (Radio Frequency Identification) tags and artificial intelligence programs for management.

According to Gartner’s forecasts, the introduction of high-tech meters will contribute to the active use of the Internet by utilities. In second place will be protection technologies, in particular surveillance cameras. Further development of the Internet of Things will contribute to the automation of buildings, transport and healthcare systems [11].

Research firm Juniper Research predicts that the global market for IoT technologies based on mobile networks will grow from US\$31 billion in 2022 to US\$61 billion in 2026, nearly doubling in size. This growth will be driven by the introduction of 5G and cellular Low Power Wide Area Network (LPWA), which will allow devices to work virtually everywhere [12].

The countries that occupy the first places in the development and implementation of IR are the USA, China and South Korea, which have a developed industry of micro-processors and embedded computers. In addition, significant progress in this field is observed in European countries and Japan [8].

Let’s consider the ranking of the cities leading in the application of Internet of Things technology in the world. If we take the local level, then one of the most famous projects is “EasyPark”. At the moment, the “EasyPark” program has already been implemented in the cities of 14

countries: Sweden, Denmark, Norway, Germany, France, Finland, Italy, Spain, Austria, the Netherlands, Australia, Serbia, Belgium and Slovenia.

In addition, the McKinsey Center conducted a study of 15 leading cities in the world in various categories and obtained the following results: in terms of smart parking development, Montreal (Canada) is in first place, in terms of car sharing development – Vancouver (Canada), in terms of traffic development – Kuhar (Denmark) and for the development of public transport – Taipei (Taiwan). The USA is the leader in economic development. Stavanger (Norway), Singapore (Singapore), New York (USA) and Vienna (Austria) are leading in the level of digital development [13].

In Asia Pacific, the manufacturing sector is expected to have the highest growth rate in the Internet of Things (IoT) market due to major government projects such as “Made in China 2025”, “Making Indonesia 4.0” and “Make in India”. In this region, the manufacturing sector has undergone technological evolution and automation, and the population has grown significantly, forcing industrialists to increase production. To meet the needs, they are actively implementing Internet of Things (IoT) technologies in various processes.

It is predicted that spending on the Internet of Things in the US healthcare sector will increase to almost \$188.2 billion by 2025, while in 2020 the figure reached \$72.5 billion [14].

Ukraine implements many innovative projects that use advanced technologies and have the potential to create a sustainable and smart city. However, Ukrainian cities face significant problems, such as insufficient organization of transport connections, lack of an effective household waste management system, danger for residents, low quality and unreliability of services in the field of water supply, heating, and medical care. Solving these problems is a key task in the construction of smart cities in Ukraine. Although Ukrainian cities are just beginning to implement smart technologies, the Internet of Things accelerator laboratory – IoT Hub in Kyiv opened in the summer of 2015. She specializes in supporting hardware startups and is involved in product development and improvement. Mobile operators in Ukraine also actively contribute to the implementation of the Internet of Things. In 2018, the “lifecell” company, together with IoT Ukraine, included the “Smart City” program in Kyiv and Lviv, based on Internet of Things research. Later, Vodafone also started research in this area.

Calculating the total number of companies in the IT sector is currently difficult because many IT companies, including technology services, startups and product companies, have their headquarters abroad. According to the latest report of the Ukrainian IT Association, there are approximately 4,000 companies operating on the market, of which 2,300 are actively engaged in labor market activities [15]. A report on software development, created by AVentures together with other partners, states that there are 245 companies with 50 or more employees and 750 companies providing IT development services in general [16].

Over the past 10 years, there has been a significant increase in the volume of exports of the Ukrainian ICT industry. According to the results of 2022, the IT industry brought 6 billion US dollars in export revenue to

the country's economy [17]. Judging by the data of the National Bank of Ukraine, over the past 6 years, the volume of exports of computer services grew by an average of 26.8% every year and reached \$6.9 billion in 2021. USA [18]. The goal of the IT industry is to increase the volume of exports of IT services and support the growth of the share of products.

The main countries to which Ukraine exports ICT services are: the European Union (Great Britain, Cyprus, Germany, the Netherlands, Ireland, Sweden), the United States of America, Switzerland, Norway, Israel, Canada and South Korea.

The successes of Ukrainian developments and the application of the Internet of Things (IoT) technology were discussed at the 20th industrial forum "The Best Ukrainian Cases of Industry 4.0", which took place on November 16, 2022 [19]. One of the vivid examples is the IT-Enterprise company, which presented at this event the innovative product KOEEBOX, which is related to remote monitoring and control of production equipment for maintenance tasks. Installation of the device and obtaining data on the performance of the equipment can be done within 15 minutes. A significant number of users in the country have already rated KOEEBOX.

In Ukraine, certain technologies of the Internet of Things, for example, such as autonomous transport, robotic warehouses and others, are not yet used. However, in the

future, in the medium term, the introduction of these technologies will be inevitable.

Conclusions

Therefore, the application of Internet of Things technologies will lead to the transformation of various industries and spheres of life, taking into account their economic significance and impact on the consumer experience.

It is worth noting that Europe takes the first place in the field of Internet of Things. The COVID-19 pandemic further stimulated consumers and businesses to actively use digital services and technologies and, as a result, accelerated the digital transformation of certain business sectors by several years. Statistics show the important role of IoT technology in the European context.

In general, Ukraine does not have a sufficiently high position in the world in the field of the Internet of Things. The main reason for this is the limited access to high-speed Internet and its key services in the country.

However, we have all the necessary conditions for making a "digital breakthrough" and moving to a higher level of technological development thanks to investments. This transition will help accelerate economic and social development. The use of digital technologies will also bring the country's economy out of the shadows. And, most importantly, the digital economy is a profitable business on which the country will be built in a few years.

References

1. Lyashenko V.I. Digital modernization of Ukraine's economy as an opportunity for breakthrough development: monograph. Kyiv: NAS of Ukraine, 2018. 252 p.
2. Zhurakovsky B.Yu., Zeniv I.O. Technologies of the Internet of Things: training. manual Kyiv: KPI named after Igor Sikorskyi, 2021. 271 p.
3. Kruts A. O. Internet of things: problems of legal regulation and implementation: scientific and practical materials. conf. Kyiv, 2017. pp. 139-141.
4. Nakonechny A. Y., Veres Z. E. The Internet of Things and Modern Technologies. Bulletin of the Lviv Polytechnic National University. 2016. No. 852. P. 3-9.
5. The fourth industrial revolution: changing directions of international investment flows / edited by A.I. Krysovaty and O.M. Sokhatska Ternopil: Yu.V. Osadtsa, 2018. 478 p.
6. Oleshko T. I., Kasyanova N. V., Smerichevskyi S. F. Digital economy: textbook. Kyiv: NAU, 2022. 200 p.
7. Howling Pixel. Internet of things. URL: https://howlingpixel.com/i-uk/Internet_of_things. (date of application: 15.08.2023).
8. Paramonov V. The Internet of Things. URL: <https://www.turkaramamotoru.com/uk/Интернетречей-20010.html>. (date of application: 15.08.2023).
9. Definition Internet-of-Things-IoT. URL: <https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT>. (date of application: 15.08.2023).
10. Goldman Sachs. URL: <https://www.goldmansachs.com/intelligence/pages/internet-of-things/index.html>. (date of application: 15.08.2023).
11. Gartner, Inc. URL: <https://www.gartner.com/en/documents/4562999>. (date of application: 15.08.2023).
12. Juniper Research Ltd. URL: <https://www.juniperresearch.com/researchstore/sustainability-technology-iot/cellular-iot-strategies-research-report?ch=IoT>. (date of application: 15.08.2023).
13. Modern trends in the use of Internet of Things technologies in the implementation of electronic governance at the local level. URL: <https://knute.edu.ua/file/NjY4NQ==/a5ca047f55d08f0d45d3b7ca053ac9f2.pdf>. (date of application: 15.08.2023).
14. IoT Analytics GmbH. URL: <https://iot-analytics.com/iot-market-data/global-iot-enterprise-spending/>. (date of application: 18.08.2023).
15. IT Ukraine Association. URL: <https://itukraine.org.ua/>. (date of application: 18.08.2023).
16. nuPSYS company. URL: <http://www.nupsys.com/iot.html>. (date of application: 18.08.2023).
17. State Statistics Service of Ukraine. URL: <https://www.ukrstat.gov.ua/>. (date of application: 20.08.2023).
18. National Bank of Ukraine. URL: <https://bank.gov.ua/>. (date of application: 20.08.2023).
19. Industry 4.0 in Ukraine. URL: <https://industry4-0-ukraine.com.ua/>. (date of application: 15.08.2023).