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International Centre for Enterprise and Sustainable

"ECONOMICS FOR ECOLOGY"

Materials
International scientific-practical conference
(Ukraine, Sumy, May 16-19, 2023)

Sumy
Sumy State University
2023

УДК : 333.7:502.7

Авторський знак: S70

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Approved by the Academic Council of Sumy State University
(order № 0586-I, 03 July, 2023)

Economics for Ecology : Proceedings of the International Scientific and Practical Conference, Sumy, May 16–19, 2023 / edited by Karintseva Oleksandra and Kubatko Oleksandr . – Sumy : Sumy State University, 2023 – 104 p. ***(electronic edition)***

For scientists, scientists, students, graduate students, representatives of business and public organizations and higher education institutions and a wide range of readers.

INDUSTRY 4.0 AND ITS INFLUENCE ON THE SUSTAINABLE DEVELOPMENT

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Industry 4.0 is revolutionizing the way companies manufacture, improve and distribute their products. Manufacturers are integrating new technologies, including Internet of Things (IoT), cloud computing and analytics, and AI and machine learning into their production facilities and throughout their operations.

This digital technologies lead to increased automation, predictive maintenance, self-optimization of process improvements and, above all, a new level of efficiencies and responsiveness to customers not previously possible.

Developing smart factories provides an incredible opportunity for the manufacturing industry to enter the fourth industrial revolution. Analyzing the large amounts of big data collected from sensors on the factory floor ensures real-time visibility of manufacturing assets and can provide tools for performing predictive maintenance in order to minimize equipment downtime.

Internet of Things (IoT)

The Internet of Things (IoT) is a key component of smart factories. Machines on the factory floor are equipped with sensors that feature an IP address that allows the machines to connect with other web-enabled devices. This mechanization and connectivity make it possible for large amounts of valuable data to be collected, analyzed and exchanged.

Cloud computing

Cloud computing is a cornerstone of any Industry 4.0 strategy. Full realization of smart manufacturing demands connectivity and integration of engineering, supply chain, production, sales and distribution, and service. Cloud helps make that possible. In addition, the typically large amount of data being stored and analyzed can be processed more efficiently and cost-effectively with cloud. Cloud computing can also reduce startup costs for small- and medium-sized manufacturers who can right-size their needs and scale as their business grows.

AI and machine learning

AI and machine learning allow manufacturing companies to take full advantage of the volume of information generated not just on the factory floor, but

across their business units, and even from partners and third-party sources. AI and machine learning can create insights providing visibility, predictability and automation of operations and business processes. For instance: Industrial machines are prone to breaking down during the production process. Using data collected from these assets can help businesses perform predictive maintenance based on machine learning algorithms, resulting in more uptime and higher efficiency.

Edge computing

The demands of real-time production operations mean that some data analysis must be done at the «edge»—that is, where the data is created. This minimizes latency time from when data is produced to when a response is required. For instance, the detection of a safety or quality issue may require near-real-time action with the equipment. The time needed to send data to the enterprise cloud and then back to the factory floor may be too lengthy and depends on the reliability of the network. Using edge computing also means that data stays near its source, reducing security risks.

Cybersecurity

Manufacturing companies have not always considered the importance of cybersecurity or cyber-physical systems. However, the same connectivity of operational equipment in the factory or field (OT) that enables more efficient manufacturing processes also exposes new entry paths for malicious attacks and malware. When undergoing a digital transformation to Industry 4.0, it is essential to consider a cybersecurity approach that encompasses IT and OT equipment.

Digital twin

The digital transformation offered by Industry 4.0 has allowed manufacturers to create digital twins that are virtual replicas of processes, production lines, factories and supply chains. A digital twin is created by pulling data from IoT sensors, devices, PLCs and other objects connected to the internet. Manufacturers can use digital twins to help increase productivity, improve workflows and design new products. By simulating a production process, for example, manufacturers can test changes to the process to find ways to minimize downtime or improve capacity.

Today, it is no longer possible to determine the state and directions of development of the capital market without taking into account the impact of digital transformations. The processes of internationalization and globalization in the world economy have created the basis for the formation of a stable network of interconnections and communication channels that provide access to financing through the active involvement of business angels, venture capital investors and funds, development programs initiated, among other things, by corporations. Such resources, due to technology, have become more accessible to all countries of the world. However, Industry 4.0 is characterized by risks associated with increased instability and the level of possible chaos. Changes in production processes are not

only technological innovations, but also political reforms. Continuing the «digital» revolution, the world system will feel the impact of a new stage at which technological innovations are changing the organic structure of the capital of transnational companies.

This trend can change the lifestyle of people, socially stratify society. The emergence of automated solutions for complex problems reduces the value of low- and medium-skilled labor of the population. This will affect the material condition of the middle class of countries. Without the possible investment of financial resources by transnational companies in the development of human capital in countries, there will be peculiar barriers to the entry of highly skilled labor into the world market. Reducing the cost of low-skilled human labor will lead to the loss of developing countries, the benefits of cheap labor and the ability to develop, and this will further stratify society.

The Fourth Industrial Revolution and global transformations are not taking place simultaneously around the world. As a rule, leading industries and countries appear that bear the greatest risks and costs for the initial development of a new technological cycle, and they also receive the maximum level of innovative super-profits. According to a study conducted by Ukrainian scientists, the leaders of Industry 4.0 today are the USA, Germany, Japan, France, China, South Korea, the Netherlands. The path of innovation is picked up, developing industries and countries where there is a "copying" of existing technologies, which is associated with less risk, but also brings less profit. Underdeveloped countries do not have the resources to master new technologies, use generations of technology of bygone technological cycles.

The processes of integration and testing of Industry 4.0's achievements into economic practice taking place in the modern world also concern Ukraine.

For further innovative development of the national economy, additional financial resources, technological transfer and testing of innovations used by structures of transnational type of entrepreneurship are needed. Factors of *positive* influence include: attractive geopolitical position; availability of skilled labor at a relatively low cost; the presence of a significant material and raw material base (powerful resource potential); Ukraine's participation in many international organizations, illustrating its desire to develop international business; the existing economic potential of the national consumer market. The factors of *negative* impact include the following: low level of solvency of the population; unfavorable business climate; a significant share of the shadow economic component, an unstable legislative and regulatory framework, especially in matters of protection of intellectual property rights (often a decisive factor influencing the decision of TNCs to work in Ukraine); frequent changes in the regulatory environment and political instability; general information backwardness of the country.