INDUSTRY 5.0 - THE PERSPECTIVES AND CHALLENGES OF THE BIOECONOMY

N. Penev*

Faculty of Economics, Trakia University, Stara Zagora, Bulgaria

ABSTRACT

In this article, a study of the development of the fifth industrial revolution is made. Due to the rapid development of the bioeconomy and biotechnologies, which in turn change the environment for the functioning of industries and society, the topic is therefore extremely relevant. Different interpretations of the term "Fifth Industrial Revolution" are presented, while the key characteristics of the preceding industrial revolutions are examined and explored.

In its main part, the article analyzes the scientific studies of the vision of the fifth industrial revolution, as well as the identification of the main opportunities and threats facing the world economy, industries and society. The relationship of Industry 5.0 with the economic performance of various industries is described, as well as its impact on environmental sustainability and the reduction of resource use. Special attention is paid to the process of adaptation of the economy itself to the upcoming changes in the key value chains. Thanks to the analysis, the authors found that Industry 5.0 will be defined by a new and expanded focus consisting of three main elements: human focus, stability and sustainability. The concluding part shows the importance of balancing the economy by improving sustainable value chains, adaptive production facilities and flexible business processes.

Key words: Fifth industrial revolution, Industry 5.0, artificial intelligence, bioeconomy, innovation, sustainability

INTRODUCTION

At the present moment, the international economy is at the beginning of a new industrial revolution, which in turn is leading to a major change in economic relationships. This is all thanks to the rapid rate of improvement in biotechnology and neural networks, which in turn have given the bioeconomy the boost it needs. The COVID-19 pandemic also had a serious impact, further accelerating this process.

Most of today's activities and society itself are increasingly dependent on information technology. Despite all the changes, knowledge and science are still controlled by man. An interesting and unforeseen benefit of the emergence of the coronavirus pandemic is the need to test cross-border technology collaboration approaches that help ensure a more sustainable and inclusive global future, which is at the heart of Industry 5.0.

The concept of the industrial revolution

The term industrial revolution is a topic of analysis in the works of many researchers, philosophers and sociologists from the country and abroad, but in economic science, a unified definition of the term "Industrial revolution" has not been adopted.

One of the first attempts to give a definition was made by the English historian and publicist Arnold Toynbee (1889 – 1975), who defined the industrial revolution as a process of replacing the outdated medieval system of regulation to which the division of labor and productive forces were subject. with the competition. (1)
Another famous researcher is the Frenchman Paul Mantou (1877-1956), who came to the conclusion that "the industrial revolution is the improvement of the old productive forces, it is associated with a rapid development and sudden flowering of embryos that until then remained in a latent or latent state ". According to P. Mantou, it is necessary to consider the industrial revolution from three points of view: technical, economic and social. (4)

In defining the term industrial revolution, several areas stand out: evolutionary, cyclical and systemic. Supporters of evolutionary theories (for example, F. Engels, A. Toynbee, etc.) assume that the industrial revolution is one of the stages in the gradual development of human society, after passing through which it is completely transformed, changing the socio-economic structure. Cyclical theories define the industrial revolution as one of the cycles of the rise of the world economy. Systemists proceed from the fact that the industrial revolution is the most important stage in the development of the global world system. (2, 7)

To date, the essence of the industrial revolution can be defined as follows: qualitative changes occurring in society under the influence of a revolution in technology, technology, the way a person relates to the means of labor.

The development of the industrial revolutions
Various technological advances contribute to a significant increase in production, which in turn has an effect on industries and enterprises. As a result, new products or services appear on the market, the balance of supply and demand changes, new businesses are created, and existing industries either adapt to the changes or are liquidated. Likewise, there are changes in inter-sectoral relationships. As a result, global transformations impact various socio-economic aspects of society.

Before proceeding to identify the characteristics of the fifth industrial revolution, it is necessary to give a brief description of the four industrial revolutions that preceded it.

1. The first industrial revolution (Industry 1.0).
The first industrial revolution began in Great Britain in the mid-17th century and was driven by important technical inventions and innovations related to the use of steam power and the mechanization of the textile industry. Thanks to the introduction of new industrial equipment and the development of energy technologies, labor productivity has increased significantly, and people and goods now have the ability to travel long distances in fewer hours. Therefore, the main characteristics of Industry 1.0 are related to the rapid growth of productive forces based on large-scale machine industry, as well as the establishment of capitalism as the dominant world economic system and the acceleration of urbanization.

2. Second industrial revolution (Industry 2.0).
The second industrial revolution began in 1870 and was directly related to the application of the principles of the division of labor and the development of mass production. Its beginning and at the same time the key event can be considered the introduction of the assembly line by G. Ford, thanks to which it was possible not only to create a mass market, but also to make the car affordable. Moreover, until the beginning of the XIX century. electricity has become the main source of energy. It was much easier to use than water or steam, allowing businesses to focus their energy supplies on specific machines and then equip them with their own power sources, making the equipment more transportable. During this period, many management programs were also developed that improved the efficiency of production facilities. As a result of the second industrial revolution, the foundations of classical management theory were born.

3. The third industrial revolution (Industry 3.0).
The third industrial revolution began in 1969 with the appearance of the first programmable logic controllers and the development of information technology, including various IT systems. They made it possible to start the process of automation and robotization of production, thereby completely replacing human labor with machine labor, or at least facilitating the tasks of workers in performing complex tasks. Information processing technology has evolved from mainframes to networked personal computers, search engines, and electronic commerce. Communication ceased to depend on landlines and switched to the use of mobile phones. It is
also worth noting that Industry 3.0 has contributed to the rapid economic growth of the entire world economy, but some industries are still at the stage of the third industrial revolution. (3, 6)

4. Fourth industrial revolution (Industry 4.0). The goal of Industry 4.0 is no different from previous industrial revolutions. In essence, it is the achievement of mass production using new technologies. Obviously, in this sense, technology is driving the industrial revolution.

To date, the definition of the characteristics of the fourth industrial revolution is a subject of discussion for scientists around the world. It brings both favorable and unfavorable consequences. On the one hand, it is related to a deeper application of information and communication technologies in industry. Production systems that already use computer technology are being extended through network connectivity and equipped with a digital duplicate via the Internet. The networking of all systems leads to the creation of cyber-physical production systems. This also leads to a shift from centralized to decentralized production; smart factories are emerging, where production systems, components and individuals interact via a network, and production is almost independent. The fourth industrial revolution is directly related to the most advanced technologies of recent decades: the Internet of Things; cloud computing; big data technologies; robotics; AI.

The above technologies are generally accepted as the main technologies supporting Industry 4.0, but there are other technologies, such as 3D printing. (3, 4)

5. The fifth industrial revolution (Industry 5.0). While the previous revolution emphasized the transformation of manufacturing enterprises into intelligent IT-enabled objects that use cognitive computing and connect via cloud servers, the fifth industrial revolution will focus on reconnecting man and machine and opening up new ways of working together to increase of resources and improve production efficiency.

Based on the above description of each industrial revolution, we can conclude that Industry 5.0 is a completely different direction in the development of production and society.

Analysis of the main trends characterizing Industry 5.0

Although Industry 5.0 is a relatively new concept, there are some early academic works that describe the main features of this process. An analysis of the literature on the fifth industrial revolution shows that there is no consensus among scholars about what it will bring and how it will change business and society in detail.

There are several visions of the fifth industrial revolution.
1. Industry 5.0 will be a collaboration between humans and intelligent systems such as robots. We are talking about robots that help people work better and faster using advanced technologies: the Internet of Things, big data and virtual reality technologies. People and systems will act as partners, not competitors. At this stage of industry development, machines will take over all the monotonous, repetitive tasks, while humans will be in charge of the creative side, thus increasing control over systems and production quality levels across the board.

2. Industry 5.0 will be based on the bioeconomy. Proper use of biological resources for industrial purposes will help achieve a balance between ecology, industry and economy. According to the European Commission, the bioeconomy is "the production of renewable biological resources and the transformation of these resources and waste streams into value-added products such as food, feed, bio-based products and bioenergy". (1, 5)

The bioeconomy will be critical to building a sustainable economy and can lead to fundamental changes in industries.

The research program focuses on five areas of activity: ensuring global nutrition; ensuring sustainable agricultural production; production of healthy and safe foods; use of renewable resources for industry; development of energy carriers based on biomass.

Thus, the bioeconomy can be the basis, or at least part, of the next industrial revolution.

3. According to Michael Rada, the essence of Industry 5.0 will be the efficient use of machine and human labor in synergy with the environment. This vision focuses on preventing
waste and putting people back into the production process. (5, 6)

The scale of the economic, social and environmental problems facing humanity in recent times makes it increasingly necessary to refer to the concept of the "circular economy", which involves the transition from linear systems to cyclical ways to promote resource saving and increasing the productivity of resources at all stages of production, distribution and consumption. The concept of a circular economy is based on the Rio Declaration on Environment and Development, adopted in 1992 and containing the principles of sustainable development. As part of this approach, there is a methodology of R principles that are constantly being transformed and extended.

Michael Rada states that Industry 5.0 will be based on six principles (6R): awareness (English recognize). Businesses must recognize the opportunities presented by the industrial cycle; reconstruction (English reconsider). Companies need to evaluate and review their business and production processes. An important step is to redesign these processes to realize the advantages of the industrial cycle; realization (English realize). After recognizing opportunities and reviewing business processes, enterprises must implement improvements in business processes or introduce qualitatively new innovations; reduce (eng. reduce). The essence of the methodology is to reduce the use of resources to achieve effective results; reuse. At the heart of the methodology is the reuse of materials that are considered fit for use prior to process improvement; recycling (English recycle). The highest possible recycling is one of the main expected results of industrial recycling efforts. Naturally, the ideal is zero waste. (1, 5)

**Opportunities and threats brought by Industry 5.0**

One of the most important paradigms that characterize Industry 5.0 is the shift in focus from technological progress to a fully human-centered approach. This means that the industry must take into account social constraints, which in turn has a number of implications in terms of a safe and supportive working environment, respect for human rights and the skill requirements of workers. Since people are the main users of smart devices and services, improving living conditions and improving quality of life are the two main goals of smart cities.

In Industry 5.0, the employee should not be seen as an "expenditure", but rather as an "investment" position for the company, allowing both the company and the employee to develop. That is, the employer will be interested in investing in the skills, abilities and well-being of its employees in order to achieve its goals. This approach is very different from simply balancing employee costs with financial returns: human capital will become more valuable. An important feature of Industry 5.0 is that technology is created for people, and not the other way around - the worker does not have to constantly adapt to constantly developing technologies, he gets more rights and opportunities, and the working environment becomes more inclusive. To achieve this goal, workers must be closely involved in the development and implementation of new industrial technologies, including robotics and artificial intelligence. (5, 7)

A 2003 report published by the Safer Work International Occupational Safety and Health Program shows that all occupational accidents are the result of preventable causes and occur in the workplace. This is confirmed by the steady decline in the number of such accidents in industrialized countries. Robots can perform a number of repetitive and simpler tasks, while the potential of robotic technology is far from exhausted, especially when artificial intelligence is used. (2, 8)

However, the safety and well-being of workers is not just about ensuring and maintaining their physical health in the workplace. The mental health, emotional state, values and dignity of workers must also be considered when designing digital workplaces.

Another important aspect of the fifth industrial revolution is digital skills and the skills to be creative, entrepreneurial, flexible and open-minded.

While research and innovation are key ways to improve productivity and competitiveness, industries and companies can also benefit from
importing and adopting innovations from other countries. Diffusion of technology depends primarily on the absorptive potential that can be created through domestic investment in skills and human capital. Therefore, companies could and should play a more important role in the education and training of the workforce because they have experience, knowledge and are directly related to technology.

The fifth industrial revolution will bring a number of benefits to industry as well, from better talent attraction and retention to improved overall sustainability. In the long term, the overall benefit to the industry is increased competitiveness by successfully adapting to a changing world and new markets. In the short term, however, the required investment may put industries at risk of a temporary loss of competitiveness vis-à-vis those not yet investing in Industry 5.0. It is extremely important to carefully plan and coordinate investments to reduce this risk.

CONCLUSION
It is becoming increasingly difficult for companies to attract and retain a skilled workforce. Taking positions that require digital and/or interdisciplinary skills seems particularly challenging. At the same time, there is strong evidence that the preferences, orientations and motivations of today's workers differ significantly from those of the previous generation. Young people are more likely to be guided by social values than by stable positions or higher salaries. Therefore, to remain competitive in the recruitment market, companies must be socially responsible.

At the same time, it should be emphasized that the concept of Industry 5.0 contributes to improving the economic performance of industries, while meeting the needs and interests of workers, as well as ensuring environmental sustainability and saving resources. Resource efficiency is about producing 'better with less', optimizing the relationship between output and input. In addition, the industry of the future must be ready to quickly adapt to the changing conditions of key value chains.

Based on the analysis of the scientific literature, it can be assumed that the fifth industrial revolution will be defined by a new and expanded focus that goes beyond the production of goods and services for profit. This broader goal has three main elements: people-centredness, stability and sustainability.

Instead of taking new technologies as a starting point and exploring their potential to increase efficiency, a human-centered approach should place basic human needs and interests at the center of the production process. Instead of asking what society can do with new technology, people should ask what technology can do for them.

Sustainability means reducing energy consumption and greenhouse gas emissions to reduce the depletion and degradation of natural resources, meeting the needs of present generations without compromising the needs of future generations. Technologies such as artificial intelligence and additive manufacturing can play a large role in this process by optimizing resource efficiency and minimizing waste. Resilience refers to the need to increase the resilience of industrial production so that it can provide and maintain critical infrastructure in times of crisis. Geopolitical changes and natural crises such as the COVID-19 pandemic have highlighted the fragility of the current approach to globalized production. It must be balanced by developing sustainable strategic value chains, adaptive production facilities and flexible business processes, especially when value chains serve basic human needs such as health or safety. Post-pandemic transformation means accepting uncertainty and being ready for often unmanageable different alternatives that allow economic, social and political systems to transform towards more equitable and sustainable development paths.

REFERENCES


5. Rada, M., INDUSTRY 5.0 definition - https://michael-rada.medium.com/industry-5-0-definition-6a2f9922dc48


7. Berov, L. Economic history. Economic development of the world from ancient times to the present day, S., Open Society Foundation, 1994