

6.2 Directions of development of economic systems using artificial intelligence within industry 4.0

Artificial intelligence (AI) is one of the leading disruptive technologies of today. It changes all spheres of human activity: production, communications and product consumption. AI affects the key attributes of every person's life, including by changing him in performing routine operations in production and everyday life.

In recent years, AI has been used in various fields of social activity: medicine, education, transport, nature management, and production, providing a significant gain in time, labor, and material resources. Also, he made it possible to solve many tasks that were previously considered impossible.

Every year, the impact of artificial intelligence on business and society becomes more and more tangible. It acts as a decisive driving force for the development of economic systems.

Evolution of the use of AI in computer systems. Artificial intelligence is a branch of science, primarily computer science, that focuses on creating systems that exhibit intelligent behavior commonly associated with humans. This can be achieved by programming computer systems to perform tasks that require intellectual activity, such as understanding language, solving complex problems, learning, and many others.

This subject of research was studied by scientists long before practical results were obtained. Back in 1930, the economist D. M. Keynes in his scientific work "The Economic Opportunities of Our Grandchildren" predicted that in the next 100 years the rate of technological progress will increase rapidly and it will be necessary to use cyber-physical tools to control the activity of economic systems [190, p. 2-7]. And so it happened, artificial intelligence turned our world upside down. With the development of technologies, the amount of data that needs to be worked with increases. Proof of this is the data revolution – Big Data.

Because of this, the application of AI in the economy has become the subject of interest of many researchers (Table 1).

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Table 1. Areas of use of artificial intelligence (AI) in economic systems

Author	Direction of use of AI
1	2
Andrew In	Ensuring the function of rescue services in case of emergency events and predicting the risk of emergency situations [191].
Elon Mask	Application of AI in the field of autopilot. Study of the possible consequences of the emergence of super-powerful AI [192].
Michael Jordan	The application of AI in the field of machine learning (in particular, opportunities and limitations), as well as to achieve various social goals [193].
Demis Hassabis	Possibilities of using AI in medicine, industry, science and other fields. Prospects for the use of AI in education, in particular, with the use of computer vision methods. Analysis of security and ethical issues of AI application [194, c. 6].
Andriy Malgin	Application of AI for forecasting the demand for goods and services based on the use of large databases. In particular, the following areas are analyzed: face recognition and various objects (based on computer vision), Automation of HR processes and recruiting, provision of financial operations [196-198].
Victoria Serova	Application of AI in making business decisions and analyzing the perspectives of various areas of activity [199].
Sebastian Teepo and Mark Raskert	Possibilities of using AI in medicine. Namely, the use of artificial intelligence to diagnose and treat skin diseases such as skin cancer and psoriasis [200].
Kelly Grenan and others	Application of AI in medicine. It examines the use of machine learning to diagnose and treat mental illnesses such as depression, anxiety and schizophrenia [201].

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The development of artificial intelligence went through several stages, each of which was characterized by its achievements and limitations.

The stage of symbolic AI (1956-1980). This stage was characterized by the development of symbolic systems that used formal logic and rules to solve problems. One of the first such systems was the program "Logic Theorem prover " (1955), which could prove logical theorems. However, the relatively low speed of data processing and the complexity of modeling the real world led to a halt in the development of symbolic AI [202].

The stage of expert systems (1980-1990). At the second stage of AI development, expert systems appeared, which were based on the knowledge of specialists and used them to make decisions. The most famous expert system of that time was "MYCIN", which was used to diagnose skin and lung infections. However, the limited amount of knowledge that could be included in the system and the high costs of its development led to a decrease in the popularity of expert systems [202].

Stage of training (1990-2010). At the third stage of the development of AI, methods of machine learning appeared, in particular, learning with a teacher and without a teacher. The tutored learning method involves using data sets to train a model based on correct answers. The method of learning without a teacher is used to find relationships between data, regardless of the presence of samples with correct answers. Thanks to these machine learning methods, many new possibilities have appeared for solving complex tasks, such as pattern and language recognition, recommendations, clustering and much more [202].

The stage of neural networks (2010-present). At the fourth stage of AI development, neural networks began to play the biggest role, which makes it possible to model the behavior of human brains. Neural networks are used to solve a variety of tasks such as speech recognition, natural language processing, image and video processing, recommendation and many more [202].

The artificial internet revolution, also known as AI 3.0, is a continuation of the previous stages. It is characterized by the emergence of new technologies and concepts, such as deep learning, reinforcement learning and multi-agency, which expand the

capabilities of intelligent systems.

Currently, the concept of a clear concept or official description of the next stage of AI development does not exist. However, you can try to roughly characterize the directions that may be important for the further development of AI:

- Broadening the scope of AI: AI can be used in a wider range of sectors, including autonomous cars, medical diagnostics, environmental research and more.
- Increased interaction between AI and humans: AI can become more emotional, i.e., more intuitive and receptive to interacting with humans. This can be achieved through improvements in voice and visual recognition, as well as through the development of interaction interfaces such as voice assistants.
- Improving resource efficiency and economy: AI can help reduce resource wastage, for example through energy-efficient systems, logistics and resource management, production optimization, and more.
- Ensuring security and transparency: AI can be used to improve security and protect privacy, as well as to ensure transparency and accountability in decision-making.

Therefore, the revolution of artificial intelligence 4.0 can be aimed at the development of AI that would be more perfect, convenient for human interaction and more efficient in the use of resources. Also, an important goal of the 4.0 revolution may be to increase security and ensure transparency in the application of AI.

Technologies such as deep learning, neural networks, natural language processors, computer vision, robotics, and others can be used to achieve these goals. For example, the development of interaction interfaces may include the development of voice and gesture communication technologies with AI that allow users to interact with AI as conveniently and effectively as with ordinary people.

In the field of economics, the development of AI systems for resource management, optimization of production and logistics can significantly reduce costs and increase production efficiency. Ensuring security and transparency can be achieved through the use of AI in the field of cyber security, where AI systems help detect and prevent cyber-attacks and other security threats in the information space. Thus, the

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revolution of artificial intelligence 4.0 can be defined as a direction of AI development aimed at achieving a more perfect, convenient for human interaction and more efficient use of resources, ensuring security and transparency in the application of AI.

Artificial intelligence is an important component of Industry 4.0, as it allows computers to perform tasks that previously required human intellectual activity. Industry 4.0 is a concept related to the development of production and use of digital technologies.

Artificial intelligence can be used to improve various manufacturing processes, such as monitoring and diagnosing the condition of equipment, optimizing production processes, developing new products, and improving product quality.

AI, like any system, has its advantages and disadvantages (Figure 1).

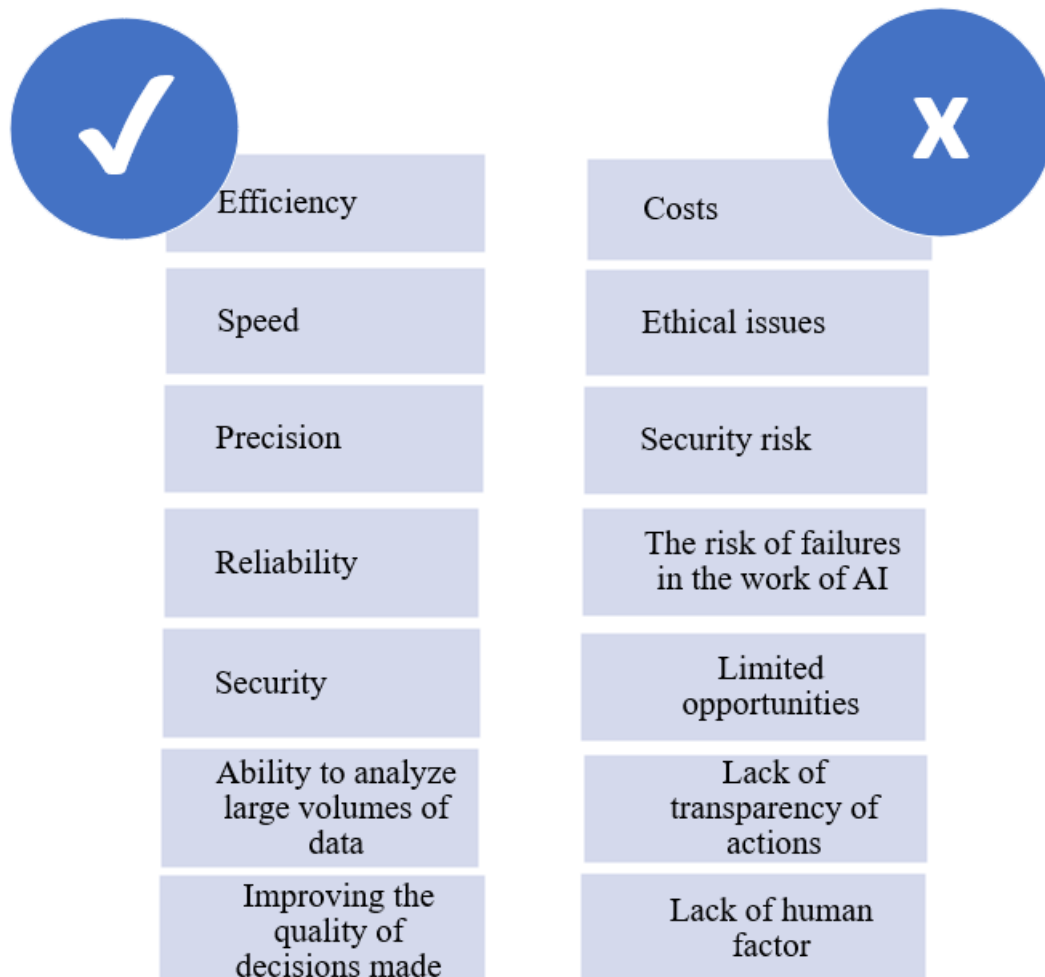


Figure 1. Advantages and disadvantages of artificial intelligence [203, c. 15]

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Advantages:

1. Efficiency and speed: AI is able to process large amounts of data and information, which allows to reduce the time and effort required to solve complex tasks.
2. Accuracy and reliability: AI is able to make accurate predictions and predict future events, which can help avoid errors and increase the reliability of processes.
3. Security: AI can be used to improve security in various fields, including the banking sector, the automotive industry, and others.
4. Problem solving efficiency: AI can be used to identify and solve complex problems, making it a useful tool for solving various tasks.
5. Improving the quality of decisions made. AI can help make more accurate predictions and reduce risk in decision-making.
6. The possibility of analyzing large volumes of data. Thanks to AI, large volumes of data can be processed and analyzed, making the process more efficient and accurate.

In addition, AI has a number of disadvantages:

1. Costs: Implementing AI can be very expensive, especially for small businesses and organizations.
2. Lack of human factor: AI cannot replace humans in all aspects of work. For example, in a business where intuition, creativity and empathy are needed, AI may be less effective.
3. Security risk: AI can become a target of hackers and attackers, which can threaten the security and privacy of data processed by AI.
4. Limited capabilities: AI can be very useful for certain tasks, but it can also be limited in other areas where human expertise is required.
5. Lack of transparency of actions: AI can solve complex problems, but at the same time it is difficult to understand exactly how its solution was made. This can lead to problems with regulation and control.
6. The risk of failures and errors in the operation of AI systems, which can have serious consequences for business and the economy as a whole.

7. Ethical issues related to the use of AI in the economy, such as the impact on the workforce, data security and the collection of personal information.

But the advantages far outweigh the disadvantages. Therefore, AI can be used in many production processes, for example, in the production of cars, where AI systems can detect product defects and recommend ways to correct them. Also, AI systems can be used in medicine to diagnose and treat various diseases, or in agricultural production to track plant growth and manage resources. Artificial intelligence allows industrial enterprises to increase productivity and reduce production costs.

The development of AI is promoted by a number of companies and organizations:

- *Google* is one of the leaders in the field of artificial intelligence and machine learning, and its DeepMind has become one of the leading research organizations in the field of deep learning and reinforcement learning.
- *Facebook* uses machine learning to improve facial recognition, text and natural language analysis, ad targeting, and more.
- *Amazon* uses artificial intelligence for product selection and recommendations, language processing and logistics management.
- *Microsoft* is engaged in the development of various intelligent systems, such as automatic translation and voice recognition systems.
- *OpenAI* is a non-profit organization founded to research and develop safe and effective AI.

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