TRENDS IN THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN TRANSITION TO INDUSTRY 5.0

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Abstract

The rapid development and implementation of digital technologies, at the global and European level, has become a strategic priority for achieving the goals of sustainable development of modern society. Expectations from the accelerated implementation of new generations of digital technologies are related to achieving a competitive, carbon-neutral and green economy. Artificial intelligence is considered as part of the technological toolkit of Industry 4.0, having the strongest transformative effect in modern society and a strategic factor for economic growth. The purpose of this report is to present the degree of application and spread of artificial intelligence among industrial enterprises in EU Bulgaria. The subject of the present study is artificial intelligence and trends for its application in the Conditions of Industry 5.0. The results show that AI is perceived as the instrument that has the strongest transformative effect in modern society and is seen as a strategic factor for economic growth. Its significant impact on the economy is associated with increased productivity, improved efficiency, creation and implementation of innovations.

Keywords: digital technologies, artificial intelligence, industrial growth, green economy, sustainable development *JEL Classification:*

Introduction

In August 2015 in New York, during the 70th UN General Assembly, the world leaders of 193 countries (193 UN members, two observer countries and 11 other countries) agreed to achieve a better future for all and adopt a new global framework for sustainable development, the 2030 Agenda, also known as Transforming the World. It reflects the first international consensus that peace, security, justice and social inclusion for all should not be separate goals, but mutually reinforcing. The program is accepted as defining sustainable development worldwide. The 17 Global Goals set in it with 169 specific sub-goals and tasks, and 238 indicators for their measurement, balance the integration of the three aspects of the concept of sustainable development — economic, social and ecological, and outline the way for the sustainable development of the Planet for the period up to 2030. The table 1 presents a comparison of the objectives in the previous program period 2000-2015 and the current period. The goals are universal, inclusive and apply to all countries around the world.

Table 1

	1	
	Objectives for SD (2000 – 2015)	Objectives for SD (2015 – 2030)
Aims	8	17
Tasks	18	169
Indicators	48	238

Comparison of the Sustainable Development Goals (2000-2015) and (2015-2030)

In support of the implementation of global goals for sustainable development and as the EU's response to the challenges of climate change and the environment, on 11.12.2019, the European Commission presented the European Green Deal, also known as the Green Deal, a year and half a year later, on 9 March 2021, the Commission announced the new Strategy for Europe's Digital Transformation to 2030, called the EU Digital Compass.

The European Green Deal aims to transform the EU into a fair and prosperous society with a modern, resource-efficient and competitive economy in which there will be no net emissions of greenhouse gases in 2050 and economic growth does not depend on the use of resources. [1] The strategic elements of the European Green Deal are presented in fig. 1



Fig. 1. Strategic elements of the European Green Pact Source: European Commission, European Green Deal, Brussels, 11.12.2019

Europe's digital transformation strategy until 2030. [4] The digital transformation strategy is based on four main pillars – skills, digital infrastructure, business and public administration. The expected results of the implementation of the strategy are summarized in fig. 2



Fig.2. Main elements and expected results of the EU digital transformation strategy Source: European Commission, COM (2021), Brussels, 9.3.2021, https://eur-lex.europa.eu/legalcontent/BG/TXT/HTML

To fulfill the goals in the digital transformation strategy, the development of technologies that led to the fourth industrial revolution in human history – Industry 4.0 - is relied upon. (Fig. 3) [3]



Fig.3. Technological toolkit of Industry 4.0 [2]

These include - technologies for the Internet of Things; big data processing technologies (Big Data); technologies for augmented and virtual reality; cyber security; cloud technologies; mobile technologies, blockchain technologies, 3D printing technologies; artificial intelligence.

Exposition

Artificial intelligence is a branch of computer science. It requires the development of computer programs to perform tasks that would otherwise require human effort and intelligence. [9] In general, AI provides the ability of a machine to imitate intelligent human behavior. [10] Artificial Intelligence applies advanced analytics and logic-based techniques, including machine learning, to interpret events, supporting the automation of decisions and action." [12].

In the literature, there are various definitions related to the essence and meaning of the concept. Research done showed that the term was first mentioned by Professor John McCarthy in 1955. According to him, AI represents "the science and engineering of making intelligent machines" [12] In Oxford Dictionary of Phrase and Fable, the term is associated with "computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages". [13] Haenlein and Kaplan, define AI as "The ability of a system to correctly interpret external data, learn from such data, and use that knowledge to achieve specific goals and objectives through flexible adaptation". [14] In the European Commission's artificial intelligence strategy, the term is defined as "systems that exhibit intelligent behavior by analyzing their environment and taking action, with some degree of autonomy, to achieve specific goals. [15]

A primary goal of artificial intelligence is to create technology that enables computers and machines to function intelligently. The common characteristic of all AI is simulating (or creating) intelligence. Companies use AI to predict customer behavior, design products and services according to end-user demand, analyze masses of data, generate real business ideas, or facilitate management decision-making. Artificial intelligence-based systems can be entirely software-oriented to the virtual world (eg voice assistants, image analysis software, search engines, voice and face recognition systems, etc.) but can also be implemented in hardware devices (e.g. advanced robots, autonomous cars, drones or IoT applications, etc.).

The results of a conducted survey related to the expectations of business and public administration for the technologies of Industry 4.0, which are going to have the strongest impact on their development in the next few years, are summarized in fig. 4.



Fig. 4. Ranking of technologies with the strongest impact in the next decade Source: www.aesc.org

First among them is artificial intelligence. It is perceived as the instrument that has the strongest transformative effect in modern society and is seen as a strategic factor for economic growth. Its significant impact on the economy is associated with increased productivity, improved efficiency, creation and implementation of innovations. (fig. 5)



Fig. 5. Impact of artificial intelligence on the economy

AI has the ability to analyze large amounts of data, build models, predict and analyze with high accuracy, etc. It is expected to develop capabilities, foster creativity, enable interaction from the synergy between man and machine.

The global artificial intelligence market size in the past year 2022 is estimated to be USD 10.79 billion. Expectations show that it will reach US\$118.06 billion by 2032, with a sustained growth of 27.02% per year on average.





According to the latest data from Eurostat, [8] the European Union is significantly behind its competitors USA and China in terms of the volume of private investments in AI. (Fig.7) Only 8% of industrial enterprises across the EU have used AI technologies, with half of them purchasing it as off-the-shelf software. (fig.8) The data for Bulgaria show a significant lag behind the average European level. Only 3% of businesses are implementing AI technologies. [7]



 Fig. 7. Private investment in AI, EU, US and China
 Fig. 8. Application of AI in EU IP for 2021, in %

 Source: https://ec.europa.eu/eurostat/statistics explained/index.php?title=Use_of_artificial_intelligence_in_enterprises

In comparison, in 2020 (Fig. 9) 1% fewer businesses in the EU used AI applications. 2% of them used machine learning to analyze big data internally, 2% used a chat service where a chatbot or virtual agent generates natural language speech for customers, 2% used robots for services that are characterized by some degree of autonomy, and 1% analyzed large databases.



Fig. 9. Enterprises using AI in the EU, 2020

Artificial intelligence is an important part of realizing the digital transformation of European society. [3] Expectations from the development of the technologies applied in the development of artificial intelligence are related to the implementation of the Green Deal in Europe, the achievement of the sustainable development goals and the economic recovery from the crisis of the COVID-19 pandemic. [17]

Given that the main goal of artificial intelligence is to create technology that allows computers and machines to function intelligently, Fig. 10 presents a model of the stages for the operation of artificial intelligence systems containing five stages.



Fig. 10. Model of stages for the operation of systems with artificial intelligence [16] Source: https://www.spiceworks.com/tech/artificial-intelligence/articles/what-is-ai/]

1. The AI system accepts data input (in the form of speech, text, image, etc.)

2. The system processes data by applying various rules and algorithms, interprets, predicts and acts on the input data.

3. During processing, the system provides a result, i.e. success or failure when entering data.

4. The result is then evaluated through analysis, discovery and feedback.

5. Finally, the system uses its evaluations to adjust inputs, rules, algorithms, and guide outputs. This cycle *continues* until the desired result is achieved.

Among the main goals of the model are: solving problems and developing abilities; continuous training; promoting social intelligence; promotion of creativity and creativity; enable synergy between human and AI.

The key tools that the AI-embedded system relies on are presented in Fig. 11.



Fig. 11. Basic tools of artificial intelligence [18]

Conclusion

Artificial intelligence is a technology of key importance for the future development of our society. It is increasingly used in various areas of social and economic life. Predictions that AI technologies will cause significant changes and a digital transformation of society make it a policy priority in the EU. Technologies that use artificial intelligence are embedded in the production and use of a number of products and services. The expectations related to the development of artificial intelligence are related to the occurrence of changes in the development of jobs, business processes, finance, marketing and a number of sectors such as health care, agriculture, the field of security, etc.

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