ARTIFICIAL INTELLIGENCE AND AUTOMATION – NEW FOUNDATIONS OF INDUSTRIAL COMPETITIVENESS IN SERBIA

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Abstract: Artificial intelligence and automation are becoming key factors in redefining industrial competitiveness in the era of Industry 4.0. They have brought significant changes to the functioning of the industry, enabling the optimization of production processes, increased efficiency, and the development of innovative solutions. By integrating technologies such as the Internet of Things, automated systems, machine learning, and robotics, industrial production becomes more flexible, adaptable, and competitive in the global market. Smart factories integrate automated structures and incorporate digital technologies that allow for resource optimization, cost reduction, and improved product quality, thereby enhancing companies' competitiveness on a global scale. The Fourth Industrial Revolution offers the Republic of Serbia the opportunity to adopt the latest innovations and catch up with the world's developed countries. The realization of Serbia's strategic industrial development goals should be based on advanced manufacturing and high-value-added services, leveraging the achievements of Industry 4.0. The authors analyze the role of artificial intelligence and automation in improving industrial production, with a particular focus on enhancing industrial competitiveness.

Serbia's new industrial policy, which emphasizes investments in innovation, digitalization, automation, and infrastructure to create an internationally competitive economy capable of succeeding in the new global market landscape.

Furthermore, part of the paper is dedicated to

Key words: Artificial intelligence, automation, industrial competitiveness of the Republic of Serbia, Industry 4.0, digitalization.

JEL classification: 033, L52, 025

1. INTRODUCTION

In recent decades, there has been a growing consensus among economists that fundamental changes are needed in our economic and social systems, and that strengthening the industrial sector is key to recovery (Lutovac Đaković, 2024). In order to achieve this important goal, industrial policy must be placed at the center of government responses. Governments should accelerate structural transformation and adopt a proactive approach to address two key challenges. The first challenge is wealth creation, which involves the reallocation of capital and labor from lowproductivity activities to high-productivity

activities. This is particularly relevant for developing countries, where low incomes and widespread poverty persist. The second challenge concerns the fact that economic development has so far been achieved at the cost of excessive exploitation of natural resources. As a result, governments around the world face a dual challenge: to accelerate structural change toward greater productivity in a way that is both socially environmentally inclusive and sustainable. Governments seeking to enhance the well-being of their citizens and preserve the environment are confronted with a considerable challenge, at least in the short and medium term. Additionally, in the aftermath of the COVID-19 pandemic, it was concluded that "post-pandemic recovery must be transformative, and countries should focus not only on economic growth, but on the direction of that growth" (Lutovac Đaković, 2024). The current moment presents an opportunity to firmly place social responsibility and ecological awareness at the core of decision-making processes, and to redefine the paradigm linking production dynamics, well-being, and sustainability (Lutovac Đaković, 2024).

Furthermore, the world is currently facing accelerated technological change and the Fourth Industrial Revolution. Artificial intelligence (AI) and automation are becoming key factors in redefining industrial development and competitiveness. These technologies are already present in numerous industrial sectors across the globe. Their application enables greater efficiency, faster data processing, optimization of production processes, cost reduction, and real-time decisionmaking.

For the Republic of Serbia, as a country in transition and a candidate for membership in the European Union, the development of new technologies and the application of artificial intelligence (AI) solutions in industry represent an opportunity to enhance its international competitiveness, attract foreign investment, and increase productivity. Serbia's new industrial policy is based on activities aimed at improving the competitiveness of domestic industry, building sectors aligned with the goals of sustainable development and competitive positioning for the new industrial revolution (priority sectors), and promoting entrepreneurship and innovation to stimulate economic growth, productivity, and employment. At the same time, the strategy envisions the development of infrastructure, simplification of trade procedures, better integration into international markets. improvements to the tax and education systems, the investment climate, and the development of clusters, research, and development (Lutovac, 2020). The overall objective of industrial policy is to enhance the competitiveness of Serbia's industrial sector. The purpose of this paper is to analyze the role of artificial intelligence and automation in modern industrial processes, with a particular focus on their application and significance for the industrial competitiveness of the Republic of Serbia.

2. GLOBAL TRENDS IN THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN INDUSTRY

Industry 4.0 is bringing fundamental changes to modern industry through the intensive application of digital technologies aimed at enhancing production processes. The core of this concept lies in the use of advanced digital solutions to improve product quality, reduce costs, and increase overall production efficiency. Data that is continuously generated, processed, and analyzed within industrial environments serves as the foundation for the creation of digital representations of entire plants and systems.

Although the initial steps toward production automation were made as early as the 1970s, only the development of modern digital technologies has enabled deeper changes and broader application within industry. The implementation of digital technologies contributes not only to the technical advancement of production, but also to the transformation of entire business models. It enables mass production of personalized products, shorter delivery times, and the creation of new revenue streams through the development of innovative products and services.

Industry 4.0, through the use of these technologies. is reshaping traditional manufacturing practices and laying the foundation for the development of smart factories characterized by high flexibility, efficiency, and competitiveness in the global market. These changes have been widely recognized across the world, with many developed countries-including Germany, France, the United States, Japan, and China-launching national strategies and initiatives focused on the digitalization of industry. Within Industry 4.0, several key technologies stand out as the drivers of this industrial transformation. These include: additive manufacturing (3D printing), which allows for rapid and flexible production; artificial intelligence (AI), which enables automated decision-making and process optimization; robotics, which improves efficiency and production precision; the Internet of Things (IoT), which connects devices and systems into a unified network; and augmented and virtual reality (AR/VR), which enhance design, employee training, and user experience (STATISTA, 2024).

"Artificial intelligence (ai) refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals" (European Commission, 2018). The advancement of artificial intelligence has made it one of today's most transformative technologies, with significant potential to reshape both industry and society. It enables the automation of complex tasks on a large scale, improves decision-making processes, and supports increasingly personalized solutions.

The market for artificial intelligence grew beyond 184 billion U.S. dollars in 2024, a considerable jump of nearly 50 billion compared to 2023. This staggering growth is expected to continue with the market racing past 826 billion U.S. dollars in 2030 (STATISTA, 2025). The Artificial Intelligence (AI) market includes software, hardware, and services that enable organizations to develop and deploy AI applications (STATISTA, 2025). Artificial intelligence (AI) occupies a central role in the transformation of modern industry, fundamentally changing the way companies operate, produce, optimize processes, and interact with the market. While analytical AI is widely adopted across industries, generative AI (genAI) remains in the early stages of adoption. Although many organizations have experimented with AI through pilot projects, scaling these efforts to achieve sustainable and transformative impact continues to pose a significant challenge. According to a WEF survey, 65% of organizations now report using genAI in at least one function (WEF, 2025). Overall, investments in AI and its applications have significantly increased. This growth is expected to continue globally, with AIrelated spending across industries projected to reach approximately \$630 billion by 2028, growing at a compound annual growth rate (CAGR) of 29% from 2024 to 2028, accompanied by an anticipated revenue of nearly \$1 trillion (WEF, 2025).

Figure 1. Integration of AI in Industry 4.0



Source: (Gabsi, 2024)

The integration of artificial intelligence (AI) represents one of the key elements in the development and implementation of the Industry 4.0 concept. In this context, AI is one of the fundamental pillars enabling digital transformation and the shift from traditional to smart manufacturing systems. The integration and

application of AI within Industry 4.0 has the most transformative impact on the manufacturing sector. The core principles of Industry 4.0 are based on digitalization, automation, and system interconnectivity, with a particular focus on the creation of "smart factories."

The application of AI goes beyond the automation of routine operations and involves the integration of advanced algorithms into almost every sphere of industrial production. The benefits of AI implementation are reflected in enhanced productivity, efficiency, and decision-making processes in manufacturing.

One of the most important areas of AI application in industry is predictive maintenance, which involves forecasting equipment failures before they occur (Lutovac Đaković, Savić, & Lutovac, 2024). This can significantly reduce unplanned downtime and maintenance costs, while also extending the lifespan of machinery. In addition, AI is used in industry to optimize production processes, automate quality control, manage supply chains, introduce circular business models, and enable intelligent decision-making.

At the national level, these developments contribute to higher economic growth and increased industrial competitiveness on the global market. In the future, many challenges will accompany AI implementation, such as data privacy protection, adapting education systems to new technologies, addressing ethical concerns, preventing discrimination, and ensuring transparency in decision-making. Furthermore, companies must invest in employee training and the development of skills required to work with AI technologies. Cooperation between industry, academia, and government is essential to overcoming these challenges and advancing the adoption of AI (Lutovac Đaković, Savić, & Lutovac, 2024).

3. INTEGRATION OF ARTIFICIAL INTELLIGENCE INTO THE INDUSTRY OF THE REPUBLIC OF SERBIA: OPPORTUNITIES AND CHALLENGES

Serbia's new industrial policy is oriented toward improving conditions for economic growth and strengthening industrial competitiveness through new investments and the development of entrepreneurship. Given the country's European perspective, this policy should be aligned with the rules and standards of the European Union. Currently, a horizontal industrial policy is being implemented, defining a set of measures and activities within intervention areas, focused on industrial restructuring toward innovative and technology-intensive sectors, while respecting the principles of sustainable development.

As there is no single, universally accepted definition of industrial policy, the definition adopted by the authors of this paper is as follows: "Industrial policy refers to the policy of industrial development, where the term 'industry' encompasses the organization and strategic management of human and material resources. The main objective of this policy is to stimulate and ensure the monitoring of structural adjustments and the restructuring of enterprises in order to enable them to cope with changes in the business environment and to face economic challenges and increasing competition at the global level" (Lutovac, 2020).

The Government of the Republic of Serbia has recognized the importance of applying artificial intelligence (AI) and advancing the digital transformation of industry, as confirmed by the adoption of the Strategy for the Development of Artificial Intelligence in the Republic of Serbia for the Period 2024-2030 (Vlada Republike Srbije, 2025). This strategy establishes the legal and institutional framework for strengthening the national AI ecosystem. The key stakeholders forming a developed AI ecosystem include the government, startup companies, and educational institutions. Within such an ecosystem, national AI initiatives, research institutes, and science and technology parks provide support for the development of AI technologies and their application in industry. The strategy promotes the use of artificial intelligence for economic and scientific development and the well-being of all citizens. The general goal of the strategy is to accelerate the development of national capacities in AI across the economy and education, while ensuring broad accessibility of AI to all citizens. The specific objectives of the Strategy are: (1) improving education and promoting artificial intelligence; (2) creating and harmonizing the legal framework and institutions for the safe, secure, and responsible use of artificial intelligence; (3) improving and facilitating the development of AI and AI-based solutions; (4) increasing the application of AI in all segments of society and the economy; (5) recognizing data as the most important resource for AI development; and (6) improving infrastructure and resources necessary for the development of artificial intelligence (Vlada Republike Srbije, 2025).

The Government of the Republic of Serbia supports projects in the field of artificial intelligence. Priority areas have been identified as medicine, transportation systems, the automotive industry, and green development based on information technologies. The application of artificial intelligence (AI) in Serbia's industrial sector represents an important step in the digital transformation of the domestic economy and in enhancing its competitiveness in the global market. When applied appropriately, AI can significantly contribute to the country's social and economic development. The use of AI in the Republic of Serbia is still in the development and implementation phase. The first to adopt new AI solutions have been companies operating in advanced manufacturing, metal processing, the food industry, the automotive sector, and logistics.

In accordance with the Fourth Industrial Revolution, an increasing number of companies in Serbia are introducing AI tools to optimize production processes, improve efficiency, detect anomalies in product quality during production, and reduce costs. Notably, the food and beverage industry has begun using AI for quality control and for monitoring certain biochemical processes (e.g., integration of electronic noses). This enables automation of monitoring and control processes, thereby increasing production efficiency and reducing the need for manual inspections (Istraživačko-razvojni institut veštačku za inteligenciju, 2025).

AI application in industry enables the monitoring and control of a wide range of production processes in a minimally invasive manner. In addition, one of the key advantages of AI is its ability to operate in environments that pose health risks to humans. In the Republic of Serbia, AI algorithms are being implemented in production planning processes. The focus is on developing AI models for predictive maintenance, which allow for early detection of potential failures and reduce downtime, thus optimizing plant operations and extending equipment lifespan (Istraživačkorazvojni institut za veštačku inteligenciju, 2025). Significant changes have also occurred in the labor market. Support provided by the current strategy includes the creation of educational models that follow these changes. This enables employees in the IT sector, as well as in other industries, to acquire the knowledge and skills needed to work with AI. One of the projects, named Tango, aims to create a synergistic interaction between humans and machines in decision-making processes. In these advanced systems, humans and machines are aligned around shared values and goals, with a clear understanding of their respective strengths, working together to achieve optimal decisions (Istraživačko-razvojni institut za veštačku inteligenciju, 2025). Nevertheless, many enterprises in Serbia still operate within traditional These companies industrial sectors. have significant potential to improve their productivity and competitiveness through the application of AI tools. For this reason, it is essential to provide training that will equip workers across various industries with the necessary knowledge and skills to work with AI. This includes developing courses and workshops for retraining and upskilling employees, integrating AI into primary and secondary education, equipping schools with advanced technologies, establishing partnerships

with tech companies, and measuring levels of technological literacy. However, the application of AI in Serbia's industry faces a number of challenges, including underdeveloped digital infrastructure, limited financial resources, and an insufficient number of qualified workers with the required competencies. Additional barriers include the slow adoption of new technologies, as AI remains unfamiliar to a large number of citizens and business entities. The introduction of AI technologies will bring significant changes in certain branches of industry. In addition to providing support to businesses, a key challenge will be the planning and implementation of training programs for employees, to ensure the rapid deployment of these new technologies (in accordance with the new strategy).

Despite these challenges, it is evident that artificial intelligence is a crucial factor in enhancing the competitiveness and sustainability of Serbia's industry. The future development of this sector will depend on effective cooperation between the government, industry, and the academic community. Furthermore, it is necessary to improve both domestic and international networking among stakeholders, promote the development of research organizations, and provide continuous support to businesses. Strengthening the legal framework, as well as improving the organization and governance of AIrelated processes, will also play a vital role.

CONCLUSION

The world is currently undergoing the Fourth Industrial Revolution, also known as Industry 4.0, which is bringing fundamental changes to the functioning of industry and the global economy. In this new industrial era, artificial intelligence (AI) and automation have emerged as key drivers of industrial development and competitiveness. The comprehensive digitalization of industrial processes is reflected in the application of advanced digital technologies aimed at improving product quality, reducing operational costs, and increasing overall production efficiency. Industry 4.0 is based on the core principles of digitalization, automation, and system connectivity, enabling dynamic management of production processes in real time. Digital technologies are increasingly being customized to meet the specific needs of various industrial sectors, with the broadest applications recorded in the automotive industry, healthcare, aerospace and defense, the chemical industry, and the consumer goods sector. Special emphasis is placed on creating agile and flexible production systems capable of rapidly adapting to changes in market conditions and demand. It is important to emphasize that dynamic, smart, sustainable, and inclusive growth is the number

one priority of the industrial policy of the Republic of Serbia. All goals, measures, and activities of this policy will be evaluated from the perspective of their contribution to enhancing industrial competitiveness and overall economic growth in the Republic of Serbia (Vlada Republike Srbije, 2020). The Government of the Republic of Serbia has recognized the importance of artificial intelligence (AI) implementation and the digital transformation of industry. One of the main objectives of AI adoption in domestic companies is to reduce inefficiencies and provide better responses to market demands. Artificial intelligence is applied across various industrial domains-from predictive machine maintenance, automation of production lines, product quality control, to supply chain optimization and real-time production planning (Vlada Republike Srbije, 2025). Serbian industry is increasingly implementing smart systems based on the Internet of Things (IoT), robotics, and AI, laying the groundwork for the development of "smart factories." The reality is that a significant number of companies in Serbia still operate within traditional industrial sectors. These enterprises have the potential to considerably increase their productivity and competitiveness through the application of artificial intelligence (AI). Given that AI remains largely unfamiliar to many citizens and business entities, it is essential to raise the general level of awareness regarding its existence, potential, and risks. Therefore, comprehensive training programs must be implemented to equip workers across various industries with the necessary skills and knowledge to work with AI technologies. This includes the development of reskilling and upskilling courses and workshops, as well as investments in education, research, and innovation to enable full integration of AI technologies into Serbia's industrial sector. At the same time, improvements in IT infrastructure are required. Despite the challenges, it is evident that artificial intelligence represents a key factor in enhancing the competitiveness and sustainability of Serbian industry.

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