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Review paper

THE CURRENT HUB OF ARTIFICIAL INTELLIGENCE IN SERBIA

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Abstract

Artificial intelligence (AI) could bring new value to a vast number of areas of life and work. The scope of AI application is still in its early stages in Serbia, mostly in industry or agriculture workplaces, but Serbia is making significant efforts to make this area come to life. The main research question is "What is the current state of AI in Serbia?" The research concludes an investigation of the Serbian rankings in AI worldwide, existing and upcoming legislative and institutional bodies, both domestic and international, with focus on EU AI Act a novelty, novelity, which could bring a better understanding of technologies, appreciating the tremendous potential of AI, but also pointing out the risks of using intelligence opposed to humans and preventive measures. The author's aim is to keep track of the situation in AI and digital technologies and the area of availability of technologies in Serbia.

Keywords: *AI, Intelligent Tools, Governance, Legislative, Industry, EU AI ACT*

Introduction

Human-created machines are already able to do all-encompassing types of labour-intensive work. Yet, on many occasions, driven by demands for higher productivity and perhaps simply curiosity, humans have been trying to infuse human intelligence into machines, which constitutes the original motivation of AI [1]. Basically, AI enabling the machines to do things that require human intelligence. These systems can expand their intelligence and learning outside of prespecified structures and logics, as opposed to previous systems in which the logic was embedded into the code by human contributors [16]. It is common knowledge that AI runs by software and hardware. From a software perspective, AI is particularly concerned with algorithms. From a hardware perspective, AI is mainly concerned with the implementation of NN algorithms on a physical computation platform. Due to the rapid development of AI software and hardware technologies, AI has been applied in various technical fields, such as the IoT, machine vision, autonomous driving, natural language

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processing, and robotics [2]. The strategic integration of AI technologies into sustainability efforts represents a pivotal shift in how organizations tackle environmental, social, and economic challenges [3]. When AI is brought into the context of actual use, both the language of the area and its applicability are very important. Authors Stanković & Krstev point out the following claim about Serbian language "Although statistics show that the population of Serbia is well equipped to use IT, and although some important language resources and tools have been developed for Serbian, the language still lags significantly behind most European languages in terms of Language Technology (LT). This shows that a stable, dedicated and long-term investment in the development of LT for Serbian through national and international scientific and development projects is needed" [4]. In addition to technologically smart solutions, it is necessary to take care of social aspects in the process of transformation [5]. Apart from the legal regulation in which the EU may have gone the furthest, it is also important to ask the question about taking AI risks seriously. International Labour Organization (ILO) critically examine the relentless pursuit of artificial intelligence innovation, shedding light on how it can overshadow the critical need for fair labor practices and development policies that promote fairer labor market outcomes, particularly for developing countries, emphasizing the role of invisible workers and advocating for equitable and ethical practices [6]. AI is bound to bring opportunities, not only as an engine for growth and innovation, but also as a means to address some of the most pressing societal challenges in critical domains [15].

Methods and Materials

We undertook a systematic review of the literature and available sources to discover answer the research question: "What is the current state of artificial intelligence in Serbia?" The starting point of the research is the analytical method. In the theoretical part of the work, secondary sources of research, scientific and professional literature for selected areas and available data from institutions are used. Data obtained from official sources of competent institutions (chiefly Oxford Insights Reports [7,12,13,14] and EU AI Act [10]) and author' s research were systematized and processed in this review.

Research and Discussion

Governments are not only working to regulate AI and foster AI innovation, but also striving to integrate this technology into public services. Worldwide The Government Readiness Index providing comparable indicators for a countries in the world, Oxford Insights concludes rankings of countries through the Government Readiness Index. In 2023 The Eastern European region has seen several promising initiatives in the AI regulation landscape. The Serbian government adopted Ethical guidelines for the development, application, and use of reliable and responsible artificial intelligence, which it recommends all public bodies follow. These guidelines are notable for not only listing broad ethical principles for responsible AI but also including detailed questions for AI developers and public servants to answer, acting as a self-assessment tool for whether AI systems are being developed and used responsibly. This makes Serbia only the second country in the region to have published ethical AI guidelines, after the Russian Federation. By the latest Report leading country is United States, and Serbia, at the moment is 57th country [7]. The world

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leaders in the field of AI are the United States, Singapore and United Kingdom which are large and populous countries. Figure 1 shows some rankings of top and region countries in area of AI with an emphasis on Serbia.

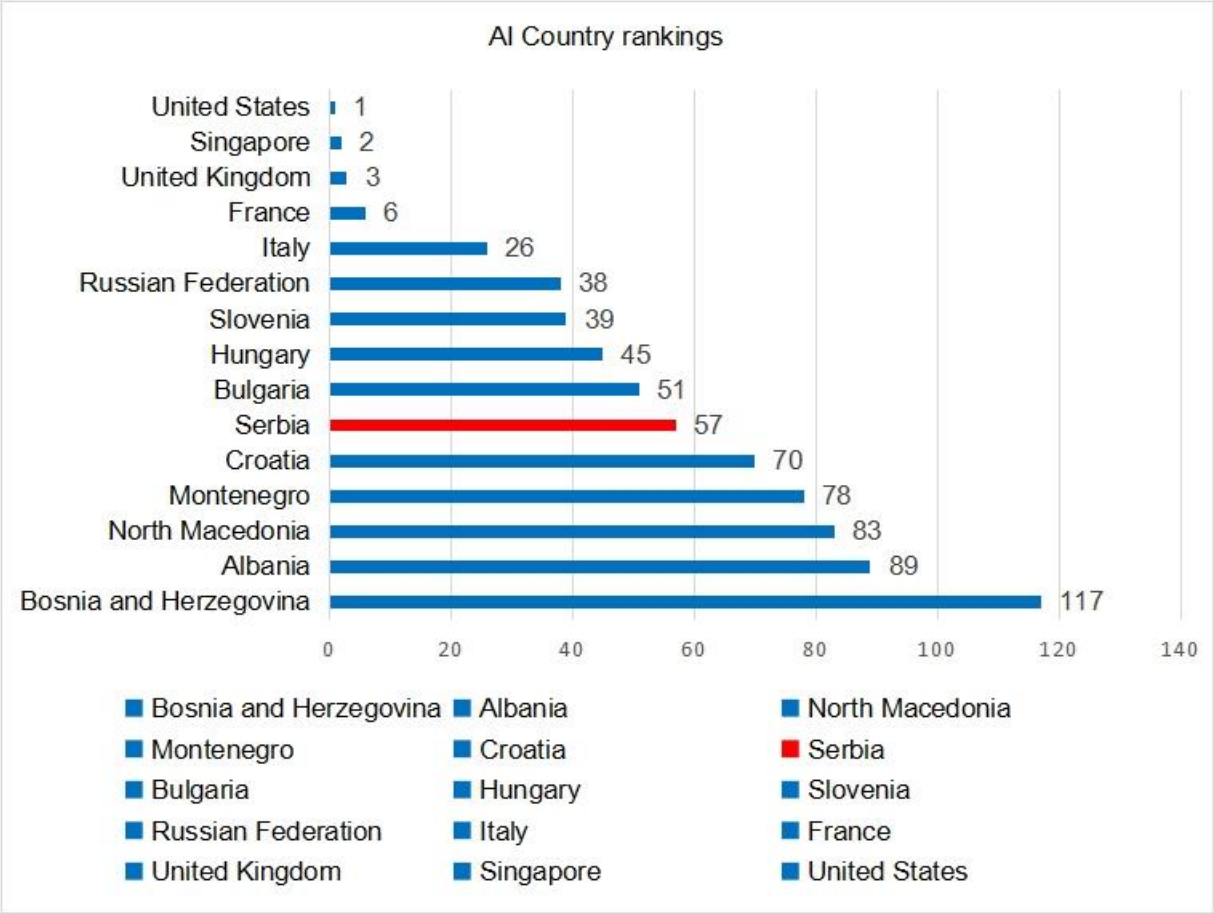

Figure 1: Rankings of countries in AI area

Source: Author ‘s systematization based on [7]

The country scores in the report are presented through the framework of grades of three pillars: government pillar (a government internal digital capacity, including the skills and practices that support its adaptability in the face of new technologies), technology sector pillar (supply of AI tools from the country’s technology sector) and data & infrastructure pillar (data’s potential cannot be realized without the infrastructure necessary to power AI tools and deliver them).

Table 1: Detailed scores timeline for Serbia with ranking trends

Year	Ranking	Total score	Government pillar	Technology sector pillar	Data & infrastructure pillar	Ranking trend
2023	57	55.57	74.29	37.13	55.30	+2

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2022	59	52.96	68.70	35.44	54.75	-7
2021	52	55.98	68.15	36.35	63.42	-6
2020	46	53.43	N/a	N/a	N/a	-

Source: Author ‘s research based on [7, 12, 13, 14]

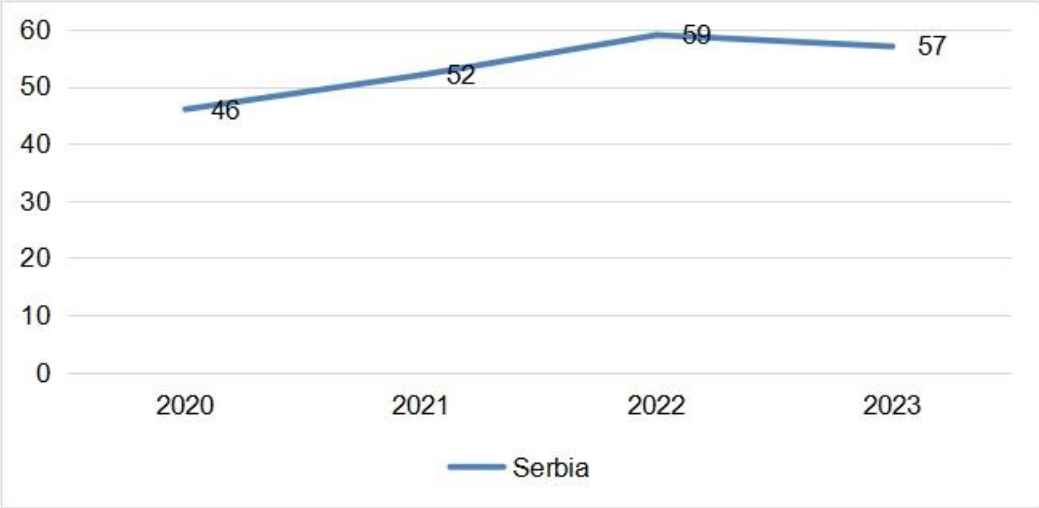

Figure 2: The trend of Serbia ‘s AI ranking

Source: Author ‘s figure

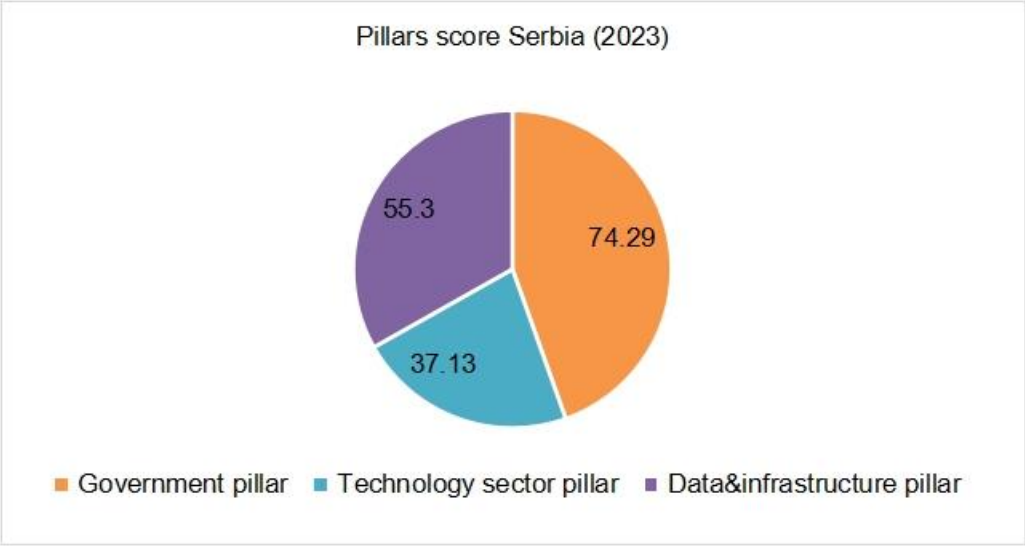

Figure 3: The pillars score of Serbia (2023)

Source: Author ‘s figure

When examine the timeline of Serbia's AI progress according to the Report, Serbia's best result so far was in 2020, with rank 46. the reasonable reason for this is that the country than has set an ambitious plan through the adoption of its Strategy for the Development of

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Artificial Intelligence for the period 2020-2025 and had plan to establish an Institute for Artificial Intelligence next year (2021). In 2021 the AI has new players, Serbian ranking is in decline, framework methodology shows that government and data & infrastructure pillar have close values, which is probably conditioned by the opening of the state data center in Kragujevac. At the moment, Serbia has very well planned and positioned two data centers, mentioned in Kragujevac and another one in Belgrade. The reason for choosing the location was preventive and safety, considering that Kragujevac and Belgrade are not on the same tectonic plates. The position of Serbia in 2023 in the world ranking is increasing, the trend is positive (+2). In the interim, Serbia shows progress in organizing its AI potentials. In order to develop and apply artificial intelligence technology in the performance of public administration bodies, research work in the academic community and its institutions and the entire industry, as well as to help start-up companies in developing their products, the National Platform for Artificial Intelligence was provided located in the State Data Center in Kragujevac.

Bearing in mind these introductory numbers, we can include Serbia among the countries where AI as a subject of research (as well as in this paper) is very expedient. It is already possible to discuss the current hub of AI, given that the legislation is in the process of being implemented both by public institutions and in the private sector. Digital transformation is no longer buzzword [8].

In recent years, attention on AI risk management has increased steadily amongst practitioners. As of 2022, several standard-setting bodies are developing voluntary AI risk management frameworks [9]. Finally in late 2023, EU adopted legal framework on AI worldwide. The AI Act is a proposed European law on artificial intelligence (AI) – the first comprehensive law on AI with the aim to with the new rules foster trustworthy AI in Europe and beyond. The AI act aims to provide AI developers, deployers and users with clear requirements and obligations regarding specific uses of AI. At the same time, the regulation seeks to reduce administrative and financial burdens for business, in particular small and medium-sized enterprises [10]. Rules are built based on risk assessment. The AI Act recognize multi-level risks with specific rules for every category.

Table 2: AI Act risk approach

Ranking	Description	Actions
Minimal risk	Minimal risk apps: recommendations, spam filters.	Free passage and absence of obligations, because these systems pose only minimal or no risk to the rights or security of citizens. on a voluntary basis, companies can commit.
High risk	Critical infrastructure (areas of water, gas and electricity); Medical devices; systems for determining access to educational institutions	Strict requirements: risk mitigation system, high quality data sets, activity logging,

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	or for recruiting people; or certain systems used in the areas of law enforcement, border control, administration of justice and democratic processes, biometric identification, category and emotion recognition systems.	detailed documentation, clear user information, human supervision and a high level of robustness, accuracy and cyber security.
Unacceptable risk	AI systems or apps that manipulate human behavior to override the free will of users, which can be very diverse.	A clear threat to people's basic rights. Forbidden.
Specific risk - transparency	Chat-bots Biometric categorization Emotion recognition systems	The starting point is that users should be aware that they are interacting with a machine. Deep fake and other AI-generated content must be flagged. Providers will need to design systems in such a way that synthetic audio, video, text and image content is marked in a machine-readable format and can be detected as artificially generated or manipulated.

Source: Author ‘s research based on [10]

The AI Act EU certainly offers comprehensive answers to the questions of regulatory artificial intelligence, but it is also full of challenges, one problem is the rapid changes and the necessity of constant improvement of the definition, while the other is its assessment-based nature. The system of penalties with high fines expressed in millions of euros seems encouraging and soothing.

Policies and the legal framework of the Republic of Serbia in this field follow the EU standards. Artificial intelligence, guided by state initiatives, is experiencing significant evolution in the Republic of Serbia. In 2018, the Government of the Republic of Serbia established the Fund for Science, with the aim of improving scientific research and financing projects in this area. A year later, in 2019, the Artificial Intelligence Development Strategy for the period from 2020 to 2025 was adopted, which envisages its application in education, economy, services in the public sector and other areas. As part of the State Strategy for the Development of Artificial Intelligence, the Government of the Republic of Serbia established the first Institute on March 18, 2021, which will deal with research into its application in various fields. The establishment of the Research and Development Institute for Artificial Intelligence of Serbia is one of the measures of the Action Plan for the implementation of the Strategy for the Development of Artificial Intelligence in the Republic of Serbia for the period 2020-2025. years. The goal of the work of the Institute, which was founded in Novi Sad in Vojvodina, is to create future personnel and attract investments in the field of artificial intelligence.

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In Serbia, artificial intelligence is used to automate repetitive tasks, which allows companies to free up employees' time for more complex and creative tasks.

Examples include:

• Financial sector: AI is used to automate tasks such as data entry, fraud detection and risk assessment.
• Customer support: AI-based chat-bots provide quick and accurate responses to customer queries.
• Healthcare sector: AI algorithms analyse medical data to identify patterns and predict potential health problems.
• Manufacturing sector: AI robots automate tasks such as assembly, quality control and packaging.

Serbia nowdays develops AI in various areas: within state administration and infrastructure, education, private sector and research sector. The Table 3 shows the development scheme.

Table 3: AI Development scheme of Serbia

Sector	Activities
State administration and infrastructure	National AI Platform Science and technology parks Application of AI in the public sector
Education (talent development)	AI in primary and secondary schools AI bachelor and master studies AI PhD doctoral studies Non-formal education - AI trainings
Private sector (companies)	AI4SME Serbia programme - in cooperation with AI Singapore (AISG) AI4SME platform for solution providers and willing to implement Global Partnership for AI (GPAI)
Research and development sector	AI Institute Fund projects for innovation activities Science fund projects Incentives for investment and development in Serbia
Ethics	UNESCO has defined the first global universal standard for the ethics of artificial intelligence, in the development of which Serbia participated and implemented. Ethical guidelines for the development, application, and use of reliable and responsible artificial intelligence

Source: Author ‘s research based on [11]

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Conclusions

AI brings with it both benefits and risks. It can be said that AI has powerful tools but is still untested. Potentially, both globally and locally, from the point of view of Serbia, perhaps the most productive decades of humanity are ahead of us. According to all indicators, the state of AI in Serbia, with institutional care, international open cooperation, and purposeful implementation, has the potential to unlock new prosperity. In Serbia, we found the strong institutional efforts, currently expressed in more powerful government pillar than in the technology and data and infrastructure pillar. International coorepation with Singapoure, the second-ranked country in global framework also can bring large-scale potentials. Progress by two places in the global AI ranking of Serbia from 59th to 57th place in 2023 is very encouraging. Ultimately, while AI holds tremendous promise for solving complex problems and improving the human experience, it is imperative to approach its advancement with caution, mindfulness, and a commitment to ethical principles to ensure that AI serves the collective well-being of society.

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