

Strategy for the Development of Artificial Intelligence in the Republic of Serbia for the period 2020-2025 (condensed¹)

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¹ To read the full version of the Strategy go to - https://www.media.srbija.gov.rs/medsrp/dokumenti/strategy_artificial_intelligence.pdf

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Pursuant to Article 38 of the Law on the Planning System of the Republic of Serbia (“Official Gazette of the RS”, No. 30/18),

the Government adopts

The Strategy for the Development of Artificial Intelligence in the Republic of Serbia for the period 2020-2025

1 Introduction

The Strategy for the Development of Artificial Intelligence in the Republic of Serbia for the period 2020-2025 (hereinafter: Strategy) defines objectives and measures for the development of artificial intelligence whose implementation should result in economic growth, improvement of public services, advancement of scientific staff, and development of skills for the jobs of the future. Also, the implementation of the Strategy measures should ensure that artificial intelligence in the Republic of Serbia is developed and implemented in a safe manner and in accordance with internationally recognized ethical principles, in order to exploit the potential of this technology to improve the quality of life of each individual and the society as a whole, as well as to achieve Sustainable Development Goals.²

The Strategy is in line with the European Artificial Intelligence Initiative³, which sets out the European Commission’s artificial intelligence policy. In this context, the Republic of Serbia, as a candidate for EU membership, but also as a participant in the European Union Framework Program for Research and Innovation, seeks to provide the necessary extent of compliance with the European Union, which will enable full integration into the European Research Area and closer cooperation.

1.1 Legal basis

The legal basis for drafting the Strategy are the Law on the Planning System (“Official Gazette of the RS”, No. 30/18) and the Decision on the Formation of the Workgroup for the Preparation of the Artificial Intelligence Development Strategy in the Republic of Serbia for the period from 2020 to 2025 (“Official Gazette of the RS”, No. 73/19).

1.2 Reasons for adopting an artificial intelligence strategy

Artificial Intelligence (hereinafter: AI) started to develop several decades ago with highs and lows. The early years of this decade saw the rapid development and expansion of implementation thanks to the breakthroughs in the field of deep neural networks, the increasing amount of available data suitable for machine learning, as well as the increasing availability of microprocessors suitable for large-scale numerical calculations. Many effects of AI are already visible, so this technology is expected to shape the development of all segments of the economy and society.

AI has the characteristics of a general-purpose technology, such as a steam engine, rail or electricity, as its application spreads to all areas of the economy and society and brings about revolutionary changes in many of them.

²In 2015, the countries adopted the 2030 Agenda for Sustainable Development and 17 global goals (Sustainable Development Goals).

³“Artificial Intelligence for Europe”, COM(2018) 237 final, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A237%3AFIN>

Due to the expected changes brought about by AI, many countries have embarked on a strategic approach to AI development and, so far, around 30 countries have developed strategies for AI development, with global economic leaders and Western European countries leading the way. In the region of Southeast Europe, no country has published an AI strategy yet.

In 2019, Serbia documented an annual growth of ICT services export of over 20% for the fifth consecutive year⁴, which also reflects the growth of the ICT industry. Economic growth, digitalization and education are key priorities of the Government of the Republic of Serbia and AI is one of the areas with the greatest potential to contribute to these priorities. By adopting and implementing this Strategy, Serbia will take the lead in AI development in the region.

Artificial intelligence can improve the efficiency of public administration and the quality of services that the state provides for citizens and the business sector.

In addition to the potential benefits in the form of economic development and efficiency improvement, the development of artificial intelligence holds certain challenges. These are, first and foremost, the protection of personal data, the risk of inheriting bias and discriminatory factors, the emergence of new professions and the increasing or decreasing need for the existing ones, the education system's challenge of preparing students for jobs of the future, the provision of transparency, and other ethical issues.

Consequently, this Strategy is being developed as one public policy document containing the definitions of the direction of development and the objectives to be implemented in favor of improvement in this field, as well as establishing clear, measurable and concrete measures contributing to the development of artificial intelligence for all sectors in Serbia.

1.3 Strategy preparation

In accordance with the decision of the Government of the Republic of Serbia on the formation of a workgroup for the preparation of the Strategy for the Development of Artificial Intelligence in the Republic of Serbia for the Period from 2020 to 2025 ("Official Gazette of the RS", No 73/19), a workgroup for the preparation of the Strategy (hereinafter: Workgroup) was formed at the initiative of the Prime Minister's Office. The workgroup is composed of representatives of the Prime Minister's Office, ministries (Ministry of Education, Science and Technological Development, Ministry of Economy, Ministry of Trade, Tourism and Telecommunications, Ministry of Finance, Office of the Minister without portfolio in charge of innovation and technological development), institutions (Office for Information Technologies and Electronic Governance, the Science Fund of the Republic of Serbia, Science and Technology Park Belgrade), representatives of the University of Belgrade (Faculty of Electrical Engineering, Faculty of Mathematics, Faculty of Mechanical Engineering, Faculty of Organizational Sciences, Teacher Education Faculty, Mihajlo Pupin Institute), the University of Novi Sad (Faculty of Technical Sciences), the University of Kragujevac (Faculty of Natural Sciences and Mathematics) and the University of Niš (Faculty of Electronic Engineering), representatives of the business sector engaged in the development and implementation of artificial intelligence as well as representatives of the Vojvodina ICT Cluster, the Petlja Foundation, the Serbian Chamber of Commerce and the World Bank. With the support of the World Bank, an international expert in this field was hired to hold consultations and a workshop with members of the Workgroup with the aim of defining the vision and objectives of the Strategy. The document is the result of a comprehensive consultation process with the representatives of all stakeholders.

⁴ According to the data of the National Bank of Serbia on the balance of payments of the Republic of Serbia, https://www.nbs.rs/internet/cirilica/80/platni_bilans.html

2 The concept, significance and role of artificial intelligence

In the framework of this Strategy, we use the widely accepted definition of artificial intelligence offered by the European Commission's Independent Expert Group⁵: "Artificial Intelligence (AI) refers to systems that display reasonable, intelligent behavior by analyzing their environment and taking actions — with some degree of autonomy — to achieve specific goals. AI-based systems can be purely **software-based**, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems) **or AI can be embedded in hardware devices** (e.g. advanced robots, autonomous cars, drones or Internet of Things applications)."

Thereby, we have in mind that there is no universally accepted definition of artificial intelligence. Although AI is not a new term, the acceleration of its development in the 21st century caused scientists and experts to constantly revise its definition.

In the history of AI, there have been highs and stagnations, starting with logic-based approaches (1950s and 1960s), knowledge-based expert system approaches (during the 1970s and 1980s), and data-based approaches (from 2000 onwards) - with periods of frustration and reduced investment⁶.

We are now at the beginning of a new phase of high expectations encouraged by huge amounts of data and increased computing capabilities. This combination has enabled the development of machine learning (ML) in the framework of AI, as an opportunity to predict future behaviors based on large datasets on past behaviors. Machine learning represents a paradigmatic shift and potential. Traditionally, a programmer would write a computer code by setting the rules required for processing the entered data to get a response as output. In ML, the system automatically forms an algorithm based on examples of input data and expected responses. Therefore, it is said that a computer system based on ML "learns" or "trains", instead of merely executing the algorithm given by the programmer.

The current progress of AI, and especially of ML, is the result of several factors. Firstly, increasingly realistic computer games require specialized graphic microprocessors suitable for extensive parallelized numerical calculations. When the manufacturer of graphics adapters Nvidia opened the possibility to use microprocessors in graphics adapters for general purposes (through a programming interface called *CUDA*⁷) in 2007, expensive supercomputers were no longer required for the extensive numerical calculations required by ML. Secondly, vast amounts of data became available when the networks between computers and their users were established. The digitization of images, videos, voice, and text has created a data-rich environment. This has allowed artificial intelligence researchers to revise old neural network models and train them with very large datasets in order to solve some complex issues such as image recognition and machine translation. While it was previously believed that, for example, computers must understand the language and its structure before translating text and speech from one language to another, it is now possible to apply ML to millions of translated sentences with the computer learning to translate autonomously without being taught the rules of both languages. This has significantly accelerated the process,

⁵A definition of AI: Main capabilities and scientific disciplines, Independent High-Level Expert Group on Artificial Intelligence set up by the European Commission, 2018.

⁶Craglia M. (Ed.), Annoni A., Benczur P., Bertoldi P., Delipetrev P., De Prato G., Feijoo C., Fernandez Macias E., Gomez E., Iglesias M., Junklewitz H, López Cobo M., Martens B., Nascimento S., Nativi S., Polvora A., Sanchez I., Tolan S., Tuomi I., Vesnic Alujevic L., Artificial Intelligence - A European Perspective, EUR 29425 EN, Publications Office, Luxembourg, 2018, ISBN 978-92-79-97217-1, doi:10.2760/11251, JRC113826.

⁷CUDA, <https://en.wikipedia.org/wiki/CUDA>

leading to the availability of real-time translation applications for mobile phones. Thirdly, the development of ML algorithms based on neural networks has progressed and specialized software libraries are now available, implementing those algorithms via microprocessors from graphics adapters.

In 2012, these trends led to a major breakthrough in new machine learning methods, known as *deep learning*. At that time, some well-known issues, such as speech recognition and object identification in images, were more effectively solved by deep learning methods.

Although ML methods are generic, meaning that they can be applied in different fields and to different types of data, the learning outcome depends heavily on the quality of the training dataset, which often needs to be semantically annotated, further structured and refined.

On the basis of filed patents, the World Intellectual Property Organization prepares an analysis of technological trends in AI⁸. The trends are analyzed by techniques, functional applications, fields of application, key participants, and geographical locations. Analysis shows that the most widely used techniques in patent applications in the field of AI are machine learning, and within that deep learning. Among the functional applications of AI, computer vision is the most prevalent, which includes image recognition, natural language processing, speech processing, robotics, and control methods. The main fields of AI application are transport, energy, telecommunications, medicine, agriculture, and public services. As far as key participants are concerned, most of the AI patents come from the industry (consumer electronics, telecommunications, software, electricity, and car manufacturing), and fewer from university or research organizations. Geographically, most AI patents originate in Japan, the United States, and China. The abovementioned data undoubtedly indicates that AI is one of the key drivers of the Fourth Industrial Revolution, primarily because of its multidisciplinary, i.e. connecting AI with other areas in the development of innovative solutions.

Studies also indicate that artificial intelligence could double annual global economic growth rates over the next 15 years.⁹ It is expected that AI will influence growth in three ways: by improving labor productivity up to 40% due to innovative technologies that enable the same number of workers to deal with a bigger workload, by creating “smart machines” in the form of systems and programs that can learn and solve problems almost independently, and finally, by expanding innovation and innovative solutions in combination with other economy sectors which will contribute to their growth and development. The *McKinsey Global Institute* predicts¹⁰ that about 70% of companies will implement at least one type of technology based on AI by 2030, while just under a half will possess the full range of such technology. Research estimates that the global GDP will be increase by about 1.2% annually.

In recent years, a large number of state institutions around the world¹¹ have introduced the so-called chatbots or virtual assistants that answer citizens’ questions automatically. Based on the questions and answers, the system learns how to improve the responsiveness over time, thereby relieving officials and making time for less routine questions and tasks requiring expertise. In 2015, the Australian Tax Authority developed an advanced virtual assistant, “Alex”, who can provide answers to specific tax questions, such as how to correct a tax filing error, how to look into the existing debt situation, etc. *Transport for London* has created its own chatbot on Facebook, via which

⁸WIPO (2019). *WIPO Technology Trends 2019: Artificial Intelligence*. Geneva: World Intellectual Property Organization

⁹Artificial Intelligence Is the Future of Growth, Accenture, 2016

¹⁰McKinsey Global Institute, 2018

¹¹Architecture for public service chatbots, DIGIT, Directorate-General for Informatics, ISA2 Programme ec.europa.eu/isa2

real-time information about the current status or delays of subways, buses and planned works can be obtained.

Despite the considerable benefits AI development holds for the society, there are also potential and accompanying challenges that need to be considered and incorporated into the plans for further development. These are, first and foremost, the protection of personal data, the need to adapt the education system and qualifications to take full advantage of the development and deployment of artificial intelligence including non-technical areas (for example: medicine, agriculture and forestry, law), ethical challenges like the prevention of discrimination on any grounds, as prejudices and biases can be inherited through training data, the challenge of transparency, as the rules based on which the system makes decisions are often not transparent in ML, the impact on the job market and the need for continuous monitoring of the types of professions with growing and declining demand.

Without attempting to narrow down the concept of artificial intelligence, it should be emphasized once again that the reason for the adoption of this Strategy is the rapid development and expansion of artificial intelligence implementation, which began during the first years of this decade thanks to the breakthroughs in the field of deep neural networks and the consequent technological advances facilitated by this breakthrough.

3 Connection with existing policies and legal framework

According to the provisions of Article 12 of the Law on the Planning System, this Strategy represents a cross-sectoral and national strategy, and it was prepared in accordance with the provisions of Article 23 of the Law on the Planning System and is in line with other strategies, programs and plans, as well as with the applicable legislative framework.

Other policy documents related to this Strategy are:

1. The Strategy for the Development of Education in Serbia by 2020 (“Official Gazette of the RS”, No. 107/12)

The development of artificial intelligence is closely associated to the development of education. One aspect of association is the education of experts who need to be involved in the development of artificial intelligence and its implementation. Another equally important aspect is the education system’s response to the changed environment of the learners’ life and work due to artificial intelligence.

2. Scientific and Technological Development Strategy of the Republic of Serbia for the period 2016–2020 – Research for Innovation (“Official Gazette of the RS”, No. 25/16)

The Strategy for Scientific and Technological Development of the Republic of Serbia for the period 2016–2020 recognizes the need for closer cooperation between science and industry, as well as the need for support of both fundamental and innovation research. Further attention was drawn to strengthening the capacity of highly educated staff and young researchers. This strategy builds on the stated priorities of scientific and technological development with an emphasis on the development of artificial intelligence.

3. Proposal of the eGovernment Development Program in the Republic of Serbia for the period from 2019 to 2022 and Action plan for its implementation

The development of artificial intelligence implementation in public administration is directly linked to the development of eGovernment.

4. Strategy for the Development of an Information Society in the Republic of Serbia by 2020 (“Official Gazette of the RS”, No. 51/10)

Besides the priority areas, the Strategy for the Development of an Information Society in the Republic of Serbia by 2020 stipulates the provision of broadband internet access for

educational and scientific institutions, followed by the support of ICT research and innovation and the development of e-services, which represents all areas closely related to the development of artificial intelligence.

5. Strategy for the Development of Information Security for the period 2017-2020 (“Official Gazette for the RS”, No. 53/17)

Artificial intelligence is associated with information security in many ways, both in terms of security challenges of information and communication systems based on artificial intelligence and in terms of the implementation of artificial intelligence in information security measures.

6. Strategy for the Development of the Information Technology Industry for the period 2017-2020 (“Official Gazette of the RS”, No. 95/16)

According to this strategy, support of IT entrepreneurship and startups is a priority area, and the development of startup ecosystems and incentives for the investment in startup projects are pointed out as measures to increase the number of startup companies but also support other companies in developing innovative products and services. Furthermore, tax incentive policies are highlighted as one of the priority areas, and tax incentives for investing in R&D, as well as tax rate incentives for locating businesses in the Republic of Serbia are mentioned as special measures. As the Strategy also covers the development of an economy based on artificial intelligence, this section has significant touch points with the development of the information technology industry on a wider scale.

7. Strategy for Development of New Generation Networks by 2023, (“Official Gazette of the RS”, No. 33/18)

This strategy recognizes the synergy between AI and the Internet of Things, which enables remote monitoring, control and managing complex processes based on acquiring a vast amount of data from a network with a great number of sensors. The data is directed towards cloud servers and processed using AI algorithms. Data transfer is done predominantly by utilizing new generation networks.

The laws governing the areas related to this Strategy are:

1. The Law on Personal Data Protection (“Official Gazette of the RS”, No. 87/18)
A particularly sensitive issue when it comes to artificial intelligence and machine learning is the prevention of abuse of this technology and the provision of conditions enabling the protection of an individual’s data privacy, which is why particular attention is paid to this issue and to aligning the Strategy with the Law on Personal Data Protection of 2018, which also complies with the GDPR and European Union regulations in this area. The challenge identified in the regulatory framework refers to the establishment of balance between regulations in the field of personal data protection and leaving room for the development of artificial intelligence and innovations in this field.
2. The Law on the Fundamentals of the Education System (“Official Gazette of the RS”, No. 88/17, 27/18 (other law), 27/18 (other law), 10/19)
The Law on the Fundamentals of the Education System is an umbrella law in the field of pre-university education. Among other things, this law regulates the basics of the elementary and secondary education systems in terms of principles, objectives, outcomes, standards of education, knowledge, skills and attitudes, as well as the types of programs of primary and secondary education and many other issues of relevance for this area. Among the education objectives, the Law on the Fundamentals of the Education System lists the development of key competences for lifelong learning, cross-curricular competences and vocational competences in accordance with occupational requirements, job market demands, and the development of modern science and technology. Key competences for lifelong learning

include digital competence, which involves the confident and critical use of information and communication technologies for work, leisure and communication, while general cross-curricular competences for the end of primary and secondary education include working with data and information in addition to digital competence. These competences are also recognized in the Law on Primary Education and the Law on Secondary Education.

3. Law on Primary Education ("Official Gazette of the RS" No. 55/13, 101/17, 27/18 (other law), 10/19) and Law on Secondary Education ("Official Gazette of the RS" No. 55/13, 101/17, 27/18 (other law))

These two laws further elaborate on the issues of the Law on Fundamentals of the Education System relating to primary and secondary education, and are related to this Strategy for the same reason as the Law on Fundamentals of the Education System.

4. The Law on Dual Education ("Official Gazette of the RS", No. 101/17)

Among other things, the objectives stated in the Law on Dual Education are the provision of conditions for the acquisition, improvement and development of competences in accordance with the demands of the job market, the provision of conditions for further education and lifelong learning, as well as the development of entrepreneurship, innovation and creativity in each individual for his or her professional development and career. The cooperation between the industry and educational institutions is particularly important in the field of artificial intelligence.

5. The Law on Higher Education ("Official Gazette of the RS", No. 88/17, 27/18 (other law), 73/18, 67/19)

One of the challenges when it comes to the development of artificial intelligence is the deficiency of professional staff, which is why it is important to make room for appropriate advancements in the field of higher education, starting with this Law governing the higher education system.

6. The Law on the Dual Model of Studies in Higher Education ("Official Gazette of the RS", No. 66/2019)

This law stipulates that, in addition to lectures at a higher education institution, part of the education consists of practical training and working as an employee. This represents an organized process in the course of which students apply theoretical knowledge in a real working environment at the facilities of the employer and under supervision of a mentor. Thus, they have direct contact with procedures and technologies used in the business world, gain work experience and prepare for the job market. The cooperation of industry and educational institutions in the field of artificial intelligence is particularly important in higher education institutions.

7. The Law on Science and Research ("Official Gazette of the RS", No. 49/2019-3)

Science and research are among the key drivers for the overall development of the economy and society as a whole. One of the programs of institutional financing that pursues common interests for the Republic of Serbia is the program of creating a new framework for strengthening national capacities in the field of engineering sciences and advanced technologies.

Research in the field of artificial intelligence is one of the important aspects of the development of artificial intelligence in Serbia.

8. The Law on Innovation Activity ("Official Gazette of the RS", No. 110/05, 18/10, 55/13)

This law regulates more closely the issues related to innovation and its applications in further development. Artificial intelligence achieves its main effects through numerous innovative applications.

9. The Law on the Science Fund of the Republic of Serbia ("Official Gazette of the RS", No. 95/2018-353)

Continuous development and support for research and development projects and initiatives are an essential prerequisite for the overall development, as well as for the development of

artificial intelligence. Among other things, the Law on the Science Fund regulates the activities, programs and projects of the Science Fund, which provides a systematic framework for the implementation of scientific research projects in the field of innovation, infrastructure, basic and applied research, etc. Some strategic commitments may be linked to the funding of scientific research projects in the field of artificial intelligence.

10. The Law on Electronic Government (“Official Gazette of the RS”, No. 27/18)

This law regulates the performance of public administration tasks using information and communication technologies. Accordingly, the application of artificial intelligence in public administration belongs to the realm of eGovernment.

11. The Law on Electronic Communications (“Official Gazette of the RS”, No. 44/10, 60/13 (Constitutional Court), 62/14, 95/18 (other law))

In many applications of artificial intelligence, there is a need for the use of electronic communications for high-volume data transmission, with high network reliability or minimum delays. This especially applies to public mobile networks.

12. The Law on Information Security (“Official Gazette of the RS”, No. 6/16, 94/17, 77/19)

As pointed out in the explanation of the associations with the Strategy for the Development of Information Security in the Republic of Serbia for the period 2017-2020, artificial intelligence is associated with information security in many ways. On the one hand, information and communication systems based on artificial intelligence bring about specific security challenges, on the other hand, artificial intelligence is often used in measures for information security.

4 Description of the current situation

A comparative analysis of initiatives and policies, as well as concrete solutions based on artificial intelligence that are developed and used in various countries in the European and wider international context, but also the consultations with members of the Workgroup being eminent industry and academic experts have revealed that the determination of the current state and the potential for further development and deployment of artificial intelligence in the Republic of Serbia requires the consideration of the current situation **in key sectors** that can be influenced by the development of artificial intelligence in the most beneficial ways. In this context, the need for reviewing the situation in the private sector, the education system and scientific research activities, the public sector, as well as the review of the potential impact and benefits for individuals and society as a whole, has been identified.

In addition to the situation in key sectors, the situation needs to be considered with respect to the required **key preconditions**, which condition the development and application of this technology. These are, first of all, the existence of adequate infrastructure and the availability of data as a resource, but also the existence of an adequate legal framework that will enable the research, development and use of socially useful solutions based on artificial intelligence, while preventing the abuse of this technology and ensuring the adherence to ethical principles and security of the individual.

4.1 Situation in Serbia as measured by the Artificial Intelligence Readiness Index

Of the existing international indicators of the artificial intelligence status, the Artificial Intelligence Readiness Index¹² (hereinafter: Index) is the only one providing comparable indicators for a large number of countries in the world (194). This Index is still in development and so far only two reports have been published, and it has been used as an indicator of Serbia's position in the comparative perspective.

Based on the 2019 Report, Serbia is ranked 58th out of 194 countries.¹³ The Index measures eleven indicators grouped into four areas: governance, infrastructure and data, skills and education, and public administration and services.¹⁴

This Index is composite, which means that the data for forming the overall score is obtained from other existing indices from previous years (some of the data dates back to 2016) and is based on the research of publicly available data. Although the focus of the Index is on the provision of public services, the indicators also show the degree of readiness of the private sector and the society as a whole for technological solutions based on artificial intelligence.

According to the Index, Slovenia is ranked highest (38th place) in comparison to other countries in the region, while Bulgaria, Hungary and Romania are ahead of Serbia. North Macedonia and Croatia rank slightly lower than Serbia, while Montenegro, Albania and Bosnia and Herzegovina are significantly less prepared for the development of artificial intelligence than Serbia.

Regional Artificial Intelligence Readiness Review according to Index		
Country	Rank	Score
Slovenia	38	6.232
Bulgaria	47	5.806
Hungary	48	5.794
Romania	55	5.54
Serbia	58	5.364
North Macedonia	61	5.284
Croatia	62	5.273
Montenegro	67	5.195
Albania	83	4.614
Bosnia and Herzegovina	95	4.183

4.2 Current situation of key sectors in Serbia

¹²This index was prepared by Oxford Insights in collaboration with the International Development Research Centre (IDRC).

¹³The results for all indicators are presented in the Appendix. The results need to be interpreted indicatively.

¹⁴Government Artificial Intelligence Readiness Index 2019, Oxford Insights and the International Development Research Centre

4.2.1 Education and science

Education is a key factor for the development of AI in Serbia. Considered from a historical point of view, Serbia offers high-quality education in the fields of technical and natural sciences, which is relevant for AI.

According to the Global Competitiveness Index¹⁵, Serbia ranks 55th in the pillar measuring skills (with a score of 68.2). The most relevant indicators in this area that also represent the prerequisites for the development of artificial intelligence are:

- **Workforce skills** measures how much companies invest in their employees' training. In terms of company investments in the employees' acquisition of skills, Serbia is ranked 104th out of 141 countries (with a score of 43.6) based on the data, which leads to the conclusion that the private sector solely relies on formal education (at school or faculty) or independent action for the acquisition of skills. This indicates that more investment in employees is needed, especially in the form of informal training or education.
- **Graduate skills** measures to what extent the skills acquired until graduation from college and high school match the skills required for working in the business environment. In this area Serbia occupies the 65th position at a global level (with a score of 51.9), which is not a bad result and speaks in favor of the previous information that the economy relies on formal education.
- **General population skills** denote the ability of citizens to read digital content or to use a computer at an elementary level. In this segment, Serbia ranks 77th (with a score of 51.5). In this segment, there is considerable room for improvement and education of the population, since the mere use of artificial intelligence implies that citizens know how to recognize when they are interacting with it (for example, when they are assisted by a virtual assistant, and not a human).

During the past few years, Serbia has become one of the leaders in Europe when it comes to education of students in the field of information technology, thanks to reforms of the education system.

Informatics is a compulsory subject in elementary schools from the fifth grade, teaching students block programming (most often the Scratch programming language), while from the sixth grade, they learn textual programming (most often using the Python programming language). In the eighth grade, they already encounter elements of data science. The number of specialized information technology departments has increased significantly to more than 50 in secondary schools, so that almost 2% of first-year high school students are educated at specialized IT departments.

Despite significant advances in the study of information technology at primary and secondary schools in the framework of general and vocational subjects, topics dealing with artificial intelligence are not yet represented to a significant extent.

Curricula in primary and secondary schools provide for cross-curricular correlations, but there is still a low level of multidisciplinary in the taught approaches to problem solving.

Higher education at most faculties for technology and mathematical and natural sciences includes subjects concerning different fields of AI, but they are still insufficiently represented. In recent years, there has been a significant increase in students' interest in IT courses at colleges. Due to increased interest, but also an increased demand of the private sector, faculty capacities have

¹⁵Global Competitiveness Report 2019: How to end a lost decade of productivity growth, World Economic Forum

increased as well. The construction of new facilities of technical faculties throughout Serbia is underway or planned. In addition to investments in spatial infrastructure, the development of new courses at faculties has been invested in.

Topics addressing artificial intelligence are represented in the study programs in different ways and to a different extent, but the learning content dealing with artificial intelligence in the study programs of computer science, computer engineering etc. is not standardized, while the required learning content dealing with, for example, operating systems, compilers, relational databases etc. is highly standardized.

As a good example of cooperation with the private and non-governmental sector, the Government of the Republic of Serbia has launched the Master 4.0 program in the framework of postgraduate studies, which includes subjects in the field of AI. Leading faculties for technology and mathematical and natural sciences in Serbia participate in the implementation of the master program. In addition to the modern program dealing with artificial intelligence and data science, students will also have lectures related to product and company development in the field of IT. Also, international experts from foreign universities will participate in the implementation of the master program.

Despite the existence of such examples, the level of cooperation of the faculties with the business sector, as well as with each other in the planning and implementation of study programs is not sufficient.

Postgraduate studies provide the opportunity for a greater degree of specialization and there is room for artificial intelligence-oriented educational profiles, which is currently underutilized.

As for informal education, it is not possible to establish a definitive list of such opportunities, but some of the key opportunities were: retraining for work in the field of information technology. So far, the Government of the Republic of Serbia has conducted retraining for beginners in the IT sector completed by about 2,000 people. Similar programs are being implemented worldwide. They represent a good example of how the business sector can quickly find the desired staff. Currently, there are international internet courses and retraining programs for AI targeting employees in the IT sector.

Up to now, retraining programs have not covered narrow professional trainings such as artificial intelligence, and short study programs have not yet provided sufficient professional training opportunities in the framework of artificial intelligence.

However, despite the quality staff Serbia has to offer (as evidenced by the remarkable successes of individual local companies and the continuous growth of ICT service exports), there are related challenges, such as:

- Insufficient staff
- Insufficient investment in startup companies
- Small number of researchers in the field of AI at universities and institutes
- Insufficient cooperation between universities and the business sector.

Also, there is a modest connection between technical faculties with AI development companies, and an almost minimal connection of other faculties (e.g. in the field of agriculture, medicine, etc.) with AI development companies.

Investment in research and development is crucial for the development of AI in Serbia. Investing in the development of science in research institutions will result in a greater scientific contribution in the field of AI, but it will also contribute to the development of education in the field of AI.

According to the Global Competitiveness Index, Serbia occupies the 55th position (with a score of 33.8) in the area of R&D measured in the framework of the pillar of innovation potential. In this area, a relevant indicator is related to the number of publications and the number of citations of scientific research. In this respect, Serbia occupies the 61st position, which indicates that there is room for improvement. By developing research in the field of artificial intelligence, Serbia can contribute to the development of science by adding an original contribution to this issue.

It is important for investments in science to be competitive. The Science Fund was established this year with the aim of making science funding in Serbia more competitive. One of the first programs of the Science Fund will be a program to support the development of artificial intelligence research.

These initial steps in the direction of an increased incorporation of artificial intelligence in research studies are important, but the research in the field of artificial intelligence is still underdeveloped. This refers to both research studies focusing on artificial intelligence as main research area and research studies focusing on other areas deploying artificial intelligence.

Also, the innovative application of modern artificial intelligence methods based on or related to the use of deep neural networks and associated scientific and technological developments is underrepresented in the research.

Cooperation between scientific research institutions, the industry and the public sector in the implementation of artificial intelligence is not yet sufficiently developed, but it is necessary, given the level of investment in the development of artificial intelligence occurring globally in the industry and the ability of the public sector to be a source of data and domains of implementation.

Research in the field of artificial intelligence in each of the scientific research institutions is usually focused on the particular aspects of artificial intelligence concerning these institutions, and no scientific research institution deals with artificial intelligence with a holistic approach.

Through the improvement of education, modernization of legislation and investment in the Innovation Fund and the Science Fund, initial steps have been taken to address these issues. Further investments in the solution of these problems via the Strategy is indispensable, with an emphasis on AI.

4.2.2 Economy

According to the data of the National Bank of Serbia (hereinafter: NBS) on the balance of payments of the Republic of Serbia¹⁶, the export of ICT services (item “Telecommunication, computer and information services” in the balance of services) has recorded a continuous growth, which is more than 20% annually during the last four years. If we add that in the first eight months of this year, the growth of ICT service exports was higher by 25.8% than in the same period last year, we can say that 2019 will be the fifth year in a row with a growth of ICT service exports of over 20% per year.

According to the general evaluation in the Vojvodina ICT Cluster report on the status of the ICT industry in Serbia¹⁷ which divides the ICT industry in the telecommunication sector and the information technology sector (hereinafter: IT sector), the IT sector in Serbia is export-oriented. According to this report, the export of IT services and software has been the main activity of 304 companies in 2016, employing over 10,000 people, which makes 47% of the total IT workforce in Serbia. This data leads to the conclusion that almost half of the IT workforce in Serbia works in

¹⁶https://www.nbs.rs/internet/cirilica/80/platni_bilans.html

¹⁷ICT in Serbia – At a Glance, Vojvodina ICT Cluster, 2018

companies exporting IT software and services. In 2016, the average income per employee was € 38,000, while the value added per employee amounted to € 29,000.

On the other hand, we can have a look at the startup ecosystem data.

According to the report by *Startup Genome*¹⁸, whose latest report included the analysis of the status of the startup ecosystem in Belgrade and Novi Sad (analyzed as one ecosystem), the Serbian startup ecosystem is in the initial development phase with an estimated value of \$ 303 mil. (\$ 5 mil. being the global average value). As an advantage of the domestic ecosystem, the Report recognizes the low VAT rate and the quality and accessibility of domestic developers. Blockchain and gaming are emphasized as most developed fields.

Of the indicators widely related to the economic area, we would highlight the following indicators from the Global Competitiveness Index:

- **Attitude toward entrepreneurial risk** measures the willingness to take risks and start one's own business. In Serbia there are strong tendencies to avoid risks in this segment, based on which Serbia ranks 107th among 141 countries (score 44.9). What is needed is the improvement and support for the development of entrepreneurial spirit.
- **Innovation capability** measures how fast innovative companies can progress and grow. In this segment, Serbia holds the 83rd position (with a score of 49.2), but the available data does not indicate the concrete barriers hindering development.
- **Cluster development**, i.e. the presence of strong clusters including the geographical concentration of companies and suppliers, manufacturers of related products and services and institutions specialized in a specific field. Concerning this area, Serbia holds the 104th position, which indicates that there is considerable room for improvement, mainly concerning connection, which can be realized through cooperation in the framework of projects dealing with artificial intelligence.
- **Cooperation between various stakeholders** measures a) the cooperation of employees within companies, b) the cooperation and sharing of ideas between companies for the purpose of innovation and c) the level of cooperation between the business sector and universities. Serbia is not ideally ranked in this field (it holds the 87th position and has a score of 3.6 out of 7) and the data supports the findings stated during consultations that respective improvement is necessary, especially improvement of the cooperation between the business sector and faculties and between companies dealing with the development of innovations based on artificial intelligence.

Concerning the part of the IT sector or the startup ecosystem dealing with artificial intelligence, there are no studies delivering precise data on the number of companies and their economic indicators.

Based on consultations with the private sector dealing with the development and application of products using artificial intelligence, we concluded that this sector mainly consists of small and medium enterprises primarily focusing on a narrow range of products and on the implementation of the existing technologies in the realm of AI. On the other hand, AI is present in projects of bigger IT companies as well, but such projects represent only a small share of their business. The presence of IT companies representing global leaders is still modest when it comes to development resources located in Serbia. However, the role of such companies can be meaningful for gaining experience and improving the skill level of local experts. Representatives of the IT

¹⁸Startup Genome, Global Startup Ecosystem Report, 2018

industry have a divided opinion on whether Serbia's priority should be attracting "big fishes" or focusing on developing the local startup ecosystem.

Although many startup companies use artificial intelligence in the development of their products and services, there is still no clear focus on the aspects of artificial intelligence in the activities aiming at the development of the startup ecosystem.

Representatives of the IT industry deem the current connection between local companies using artificial intelligence insufficient. The impression of business representatives is that one of the reasons is that local companies dealing with AI are oriented towards foreign markets. Concerning the connection of the industry with other sectors, it is recognized that the connection with universities is at a modest level as well, even if best practice examples do exist. This refers to faculties of technology and mathematical and natural sciences, where the need for a tighter connection and cooperation is more obvious. However, it also refers to other faculties, especially in the fields of medicine, agriculture and forestry. Cooperation might enable a multidisciplinary approach to the creation of innovative solutions.

Concerning the policy generally related to small and medium enterprises (hereinafter: SMEs), the preparation phase of a new strategic document for SMEs is ongoing, which will be valid after 2020, and which will recognize the significance of digital transformation, including the use of artificial intelligence as one of the elements having a great influence on and developmental potential for SMEs. In addition, the implementation of the Program Supporting the Digital Transformation of the SME sector in 2019 is underway, with the goal of establishing an infrastructure for the support of SMEs and creating possibilities for development and application of AI for the optimization of business processes and the enhancement of the business of individual SMEs.

The Chamber of Commerce and Industry of Serbia has founded the Center for Digital Transformation (CDT) – a national hub for innovative practices mostly oriented towards micro, small, and medium enterprises. The CDT supports the digital transformation of Serbian businesses through education, consulting, as well as the establishment of strategic partnerships with technology owners, on the one hand, and companies willing to integrate the respective solutions in their business, on the other.

The activities performed in Serbia for the purpose of attracting investments have no clear focus on artificial intelligence and do not include measures directly connected to artificial intelligence, be it the attraction of companies developing capacities in Serbia, the attraction of venture capital for investments in Serbian companies or support for innovation projects.

The practice of supporting the development of innovative products and services through a public procurement planning policy is generally not sufficiently represented, which naturally applies to innovative products and services in the field of artificial intelligence as well.

Considering the fact that there is an increasing amount of products and services using artificial intelligence on the market, it becomes more difficult to recognize the difference between those products and services significantly contributing to progress in the development and implementation of artificial intelligence and others just being somewhat related to artificial intelligence and therefore especially promoted. If the policies and measures aiming at economic development on a wider scale and at the information technology industry on a narrower scale are supposed to have an according focus in the field of development and implementation of artificial intelligence, clearly defined areas of special interest for the development and implementation of artificial intelligence are missing.

4.2.3 Public Sector

The strategy preparation process included the performance of a wide consulting process and an analysis enabling the identification of work areas of the public sector, as well as services where

the implementation of solutions based on AI would be most effective. The consulting process has shown that the public administration does not exploit the potential of artificial intelligence enough. In the course of consultations, three key areas have been identified, in which artificial intelligence can contribute significantly to public welfare and the provision of better and higher-quality services:

Public Administration – The enforcement of the reforms of the public administration has been accompanied by progress in the establishment of a user-oriented electronic administration via the provision of an adequate legal framework, the indispensable infrastructure and interoperability, optimization and digitalization of administrative procedures and services. Although the application of artificial intelligence in the public administration and in the public sector as a whole has not been reported so far, the vision of a modernization of services based on principles contained in the Tallinn Ministerial Declaration on eGovernment and the accompanying Annex¹⁹ is mentioned in the text of the Proposal for the Electronic Administration Development Program for the period of 2019 to 2022, which is currently in the adoption process. It explicitly expresses the readiness for the implementation of innovative technologies like artificial intelligence in the process of further development of electronic services.

Advanced solutions for business analyses and prediction (so-called business intelligence) can provide a more comprehensive and objective view of the situation and contribute to a more rational use of resources, a higher-quality and efficient administration and strategic decisions based on more information. The implementation of a conversational user interface and virtual assistant (so-called chatbots) in national portals enables the provision of services for citizens and businesses in a manner that corresponds to their specific needs more, at any moment. Intelligent solutions can provide service personalization, user support, they can facilitate the process of filling in electronic forms and the implementation of a feedback mechanism would ensure further optimization of the model. The use of artificial intelligence enables maximum acceleration of many routine procedures, where the decision on a party's request exclusively depends on objective facts like attached documentation or data which is already available in registers and records, especially in cases where it is clear and unquestionable that the party fulfills the criteria for a positive decision. When designing, developing and implementing public sector services based on artificial intelligence, it is indispensable to ensure the reliability of the implemented solution, user privacy and data protection, multi-channel access, i.e. to provide the user with an option of interaction with an officer or service provision via a contact person.

Healthcare and medicine – In the healthcare system, artificial intelligence can significantly enhance early diagnostics, it can ensure better availability of all resources and equipment and optimize their use, and it can contribute to the enhancement of the quality and efficiency of health services.

Traffic, road infrastructure and mobility in urban environments – The implementation of AI can significantly improve traffic planning and flow, enable optimization of traffic signaling and real-time traffic management, and given real-time conditions provide a rapid response to traffic situations that could not be foreseen.

¹⁹The Tallinn Declaration on eGovernment from October 6, 2017 and the "User-centricity principles for design and delivery of digital public services" Annex from the meeting of ministers during the Estonian presidency of the European Council

4.3 Current state of key prerequisites for the development of artificial intelligence

The assessment of the state of key prerequisites that may be limiting or facilitating factors is indispensable for the development of artificial intelligence and innovative solutions in Serbia. The considered key prerequisites are: regulatory framework, open data and infrastructure.

4.3.1 Regulatory framework

In many countries, the regulatory framework is facing the need for a more flexible access due to the development of artificial intelligence. Regulators are facing the challenge of establishing an adequate balance between protecting citizens and enabling the development of innovations.

Regulations having a decisive influence on the development of artificial intelligence refer to the personal data protection regulation, to flexible regulatory frameworks enabling the testing of innovations, tax treatment of innovations, and regulations concerning open data.

At EU level, the General Data Protection Act has been adopted (hereinafter: GDPR), which has tightened the requirements for collecting, processing and storing personal data. The GDPR has evoked uncertainties concerning the practical implementation of regulations, due to the general guidelines for the application of individual regulations at the level of the European Union. In 2018, Serbia adopted the new Law on Personal Data Protection, which is compliant with the GDPR, but its practical implementation in Serbia is challenging. For example, the existence of a legitimate interest in processing personal data can be interpreted in many different ways. In coordination with business representatives it has been concluded that precise instructions for concrete scenarios happening in practice might be useful. This would lead to a reduced risk of different interpretations of regulations and the private sector would be encouraged to further develop artificial intelligence.

According to the “Flexibility of regulatory framework and adaptation to the digital business” indicator from the Global Competitiveness Index, Serbia holds the 68th position (3.6 out of 7). This field leaves considerable room for improvement by adapting the regulatory framework to innovations in the field of artificial intelligence and, above all, through the establishment of exceptions on a limited market for the purpose of innovation testing.

The business representatives also recognize the need for greater flexibility in the development of regulatory solutions in order to enable development and testing of innovative solutions. Flexibility is reflected in the establishment of the so-called sandbox. The sandbox is a special regulatory framework enabling companies to test innovative solutions or business models in accordance with an approved plan and under supervision of a responsible authority with a limited number of users.²⁰ These mechanisms are mostly dedicated to the financial sector in the European Union (banking, *FinTech*, insurance). There is one such example in Serbia, which has been developed by the National Bank of Serbia and which is also used in the financial sector. The Law on Payment Services created an appropriate legal basis (in the framework of the limited network exclusion) for companies for the purpose of testing innovative payment services they are planning to introduce. Interested companies (e.g. startup companies) and entrepreneurs can test certain innovative payment models under controlled conditions, without the obligation of prior obtainment of a license for the provision of payment services. Sandbox enables the testing of the business model in the initial phase without carrying out the whole expensive process of obtaining a license, especially when the convertibility and profitability of the model cannot be completely assessed so far.²¹ In this case, it is mandatory to first consult with the National Bank of Serbia and provide insight in the

²⁰Joint Report on Regulatory Sandboxes and Innovation Hubs, ESMA, 2018

²¹National Bank of Serbia, 2017

testing, which is compliant with the practice in the European Union. From the perspective of the business sector, this model should be implemented in other areas as well, especially in areas where artificial intelligence, especially the one based on machine learning, can contribute to the development of innovations (e.g. testing of autonomous vehicles).

Startup companies and SMEs hold the leading positions concerning innovations on many markets. The access to the public procurement market creates excellent opportunities for their growth. The Public Procurement of Innovative Solutions implies the public sector's use of its purchasing power in order to act like an early adopter of innovative solutions that are still not available at a commercial level. On the other hand, the public procurement of innovative solutions enables the public sector to modernize public services and achieve savings at the same time.

Recently, the European Commission has published the "Public procurement as a driver of innovation in SMEs and public services" guide²² showing policy makers at a national and regional level what they can do in order to support innovation procurement. With the new procurement directives, the European Union has established an even stronger legal framework for innovative procurements. In addition, EU programs, and especially the European structural and investment funds, as well as the Horizont 2020 program offer interesting options for financing the public procurement of innovative solutions.

The elected board for artificial intelligence of the House of Lords states in the report "AI in the UK: ready, willing and able?"²³: "To ensure greater uptake of AI in the public sector, and to lever the Government's position as a customer in the UK, we recommend that public procurement regulations are reviewed and amended to ensure that UK-based companies offering AI solutions are invited to tender and given the greatest opportunity to participate."

The World Economic Forum Centre for the Fourth Industrial Revolution developed the "Guidelines for AI Procurement"²⁴.

The tax treatment of innovations is also important for the development of artificial intelligence. Amendments to the Corporate Profit Tax Law in 2018 caused positive developments in this area, as they enabled the recognition of expenses for research and development in the double amount, in case the research was conducted in Serbia. The same regulation reduced the profit tax rate from the company's income based on intellectual property created in Serbia from 15% to 3%. According to the *Startup Genome's* report, such tax treatment of innovative solutions is recognized as one of the key advantages of the Serbian startup ecosystem²⁵ and, based on the existing conditions, it can be concluded that the tax treatment of innovation is at a satisfactory level. Thus, there is no need for interventions, but the maintenance of the named treatment must be guaranteed for the following period.

The following issues are recognized as future key challenges concerning the regulation:

- The need for the establishment of several frameworks of a limited regulated market (sandbox) for the purpose of encouraging innovation.
- The need for adaptation of regulations concerning public procurement by the state, using innovative solutions based on artificial intelligence in order to facilitate efficiency.
- An insufficient regulation of the legal framework concerning data ownership
- Regulation of algorithmic bias (for more information see: Individual and Society).

²²<https://op.europa.eu/en/publication-detail/-/publication/f5fd4d90-a7ac-11e5-b528-01aa75ed71a1/language-en/format-PDF/source-66724746>

²³<https://publications.parliament.uk/pa/ld201719/ldselect/ldai/100/100.pdf>

²⁴http://www3.weforum.org/docs/WEF_Guidelines_for_AI_Procurement.pdf

²⁵Startup Genome, Global Startup Ecosystem Report, 2018

4.3.2 Open data

Data is an indispensable resource for the development of modern intelligent solutions and the availability of big and diverse datasets owned by public administration and business authorities is one of the key prerequisites for the development of an industry producing solutions based on AI and creating new value based on the data, as well as for the development of education and scientific research activities. The availability of data is one of the key conditions for the development and “training” of progressive artificial intelligence systems whose deployment can enable an easier and faster achievement of Sustainable Development Goals. The private sector in Serbia in the field of artificial intelligence is mostly made up of small and medium enterprises that do not have the capacity to independently collect data at this stage of development. This represents a great challenge for students, faculties and startups, which is why mechanisms need to be found that can ensure a reuse of as much datasets as possible, the ones owned by the public as well as the private sector.

4.3.2.1 Data of the public sector

In Serbia, the initiative for opening data of institutions has been introduced in 2015, when the government of the Republic of Serbia in cooperation with the United Nations Development Program and the World Bank assessed the preparedness and began to conduct the project “Open Data – Open Opportunities” based on the formulated recommendations²⁶. At the beginning of 2016, the Open Data Workgroup was formed, consisting of the representatives of institutions, civil society and expert organizations, academic institutions, business associations and international development partners with the objective to plan and coordinate activities concerning the opening of data, providing support to institutions and contributing to the education on the importance and benefits of opening data, but also to provide for continuous communication and cooperation between the public administration and the civil sector, and to encourage the demand for open data. The Office for Information Technologies and eGovernment (hereinafter: ITE Office), which institutionally manages the process of opening data in Serbia, established the National Open Data Portal in 2017²⁷ as a key element of the infrastructure indispensable for publishing, easily browsing and downloading data sets, but also as central spot connecting publishing institutions with the society of users who can contribute to the improvement of data quality and suggest the opening of new data sets by their feedback. During 2018, a comprehensive legal framework for the opening of data has been established, performing an initial adjustment to the Directive on the Reuse of Public Sector Information²⁸. Article 27 of the Law on Electronic Government²⁹ from 2018 introduced the obligation of authorities to publish data from their area of responsibility together with metadata, in a machine-readable open format and in a manner enabling easy browsing and reuse, while the Regulation on the Mode of Operation of the Open Data Portal³⁰ regulates the manner of administration of the portal, the obligations of the authorities in the portal, the usage of datasets and technical standards.

²⁶ The project “Open Data – Open Opportunities” is conducted by the Office for Information Technologies and eGovernment of the government of Serbia in partnership with the United Nations Development Program and supported by the World Bank, the UK Fund Administration and the Swedish International Development Cooperation Agency.

²⁷ The National Open Data Portal is available at: www.data.gov.rs

²⁸ Directive 2013/37/EU of the European Parliament and of the Council of 26 June 2013 amending Directive 2003/98/EC on the re-use of public sector information (PSI Directive)

²⁹ Law on Electronic Government, “Official Gazette of the Republic of Serbia”, No. 27/2018

³⁰ Regulation on the Mode of Operation of the Open Data Portal, “Official Gazette of the Republic of Serbia”, No. 104/2018

In November 2019, 241 datasets were available in the Open Data Portal, i.e. 1834 individual resources (files). At the moment of drawing up the Strategy, 45 organizations published their data, while 527 users registered accounts. Numerous trainings, lectures, activities for professional and technical support for institutions, events promoting the concept of opening and reusing data, public tenders for project proposals and “challenges”³¹ in form of public tenders that resulted in the creation of innovative web applications, portals and platforms based on open data and other activities have also been realized. **In spite of this, during the establishment of a new strategic framework in the field of electronic government, the E-Government Development Program for the period of 2019 to 2022, it has been found that the number of publishing institutions and the amount of published datasets is still not satisfactory and a range of additional measures for overcoming this situation has been formulated.** The development of the methodology and standards for the opening of data with the definition of datasets that are prioritized for opening is in process, as well as the preparation activities for the creation of the annual program for the opening of data. In this context, the private sector, academic institutions and researchers working in the field of AI must be included more in order to ensure that the annual program of opening data includes datasets of particular importance for the development of artificial intelligence.

During the consultations referring to the creation of the strategic framework for AI development, the data concerning business performance of companies, taxing and data from the field of traffic and healthcare have been identified as priority for opening.

In order to ensure an appropriate volume of available data, it is necessary to overcome challenges relating to an insufficient data production, therefore further consultation should identify areas where appropriate records, registers and mechanisms for data collection should be established.

4.3.2.2 *Data of the private sector*

The provision of private sector data for reuse can be considered from the perspective of the public sector (data provision “*business to government*”, B2G) as well as from the perspective of the private sector (data provision “*business to business*”, B2B), while the comparative practice is aware of several models through which the availability and reuse of private sector data can be ensured.

Some models of the **B2G** data provision in comparative practice³² can be: data donations as an expression of a company’s corporative responsibility, rewarding through “challenges”, partnerships, mediation, or civic data provision.

One segment in which the obligation to provide information to the public sector can be secured is in cases when private companies are entrusted with activities of public significance like utility services, public transport and similar. In order to achieve this, public procurements and contracts must contain the mandatory criterium of the private service provider’s obligation to assign the data to state authorities without reimbursement and to define the structure, form and format of data as well as the deadlines for the submission of updated data.

³¹Numerous activities are offered on Open Data Day and during Open Data Week; in 2018, an open call for proposals was launched in the field of open data, and during 2018 and 2019, open data “challenges” have been realized twice.

³²Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions “Towards a common European data space”, COM/2018/232 final, Commission Staff Working Document, Guidance on sharing private sector data in the European data economy

When it comes to data from the private sector for which no obligation of opening for reuse can be identified, consultations and comparative practice analysis have shown a need for considering the introduction of stimulating measures or tax benefits for companies providing their data. The need for the establishment of a platform for publishing and exchanging private sector data has been articulated, with clearly defined solutions for its maintenance, annotation and data storage. The need for a comprehensive catalogue of all available datasets in the public and private sector has been identified.

Concerning B2B data provision, other approaches are possible as well – from an open data model, i.e. the free provision of data for an unlimited number of users and the possibility of its monetization and market establishment, to the establishment of closed platforms offering additional services on top of the data, but also enabling better control over data use.

4.3.3 Infrastructure

The development and testing of artificial intelligence-based solutions require the provision of an appropriate infrastructure of high-performance computers and the need for a platform via which high-performance computer resources would be available for research organizations, faculties, but also small and medium enterprises and startups that are not able to provide the required resources themselves, was clearly articulated during the consulting process.

In 2017, the ITE Office founded the State Center for Data Management and Storage (hereinafter: Data Center) in Belgrade, which provides state administration authorities and government offices with the required infrastructure resources via State Cloud. At the moment, actions are taken for the establishment of a State Data Center in Kragujevac, which should, besides providing additional security for and encouragement of a further development of the electronic government system, contribute to the development of the whole ICT sector, given that one part will be intended for commercial use. Immediately after the opening of the Data Center Kragujevac, the ITE Office plans on establishing a national platform for artificial intelligence combining the most modern high-performance computer systems with a software platform and on providing the academic community, science and technology parks, the public administration and businesses with access to this infrastructure for the development of innovative solutions.

Furthermore, according to the data of the Republic Agency for Electronic Communications and Postal Services (RATEL) published in the market overview for 2018³³, all three mobile network operators have a high 4G mobile network coverage, covering between 96% and 97% of the population and between 72% and 78% of the territory of the Republic of Serbia. The accelerated development of 4G networks followed the sales of a spectrum of radio frequencies in the range of 800 MHz, which took place in 2015. The first 5G base station was experimentally launched on June 22, 2019 in the Science Technology Park Belgrade.

4.4 The individual and the society

The development of artificial intelligence brings about many advantages, but also challenges for individuals as well as the society as a whole. Although many of the challenges are still not visible, comparative practice has shown challenges like representativeness of data used for machine learning, redefinition or elimination of the need for certain professions due to the introduction of artificial intelligence, the need for additional qualification of the population for future jobs and issues concerning the responsibility for consequences of autonomous system decisions based on

³³Market Overview of Telecommunications and Postal Services in the Republic of Serbia in 2018, https://www.ratel.rs/uploads/documents/empire_plugin/Pregled%20trzista%202018.pdf

artificial intelligence like, for example, in the case of car accidents including autonomous vehicles. In order to guarantee availability, safety and an even and just use of AI, and simultaneously build trust in AI on the part of society, it is important that technological progress in the field of AI is accompanied by careful consideration and awareness and that challenges caused by the development of AI are presented.

Policies and the legal framework of the Republic of Serbia in this field follow the EU standards. The general regulation of the European Parliament and the EU Council on the protection of persons concerning personal data processing³⁴ (hereinafter: EU General Data Protection Regulation) guarantees high standards of personal data protection and requires the implementation of measures assuming the certain protection of personal data and a design of products and services in favor of data protection.

The Republic of Serbia introduced the Data Protection Law in 2009 and the currently applicable law from 2018 is compliant with the General Data Protection Regulation (EU).

The European Commission issued the press release “Building trust in human-centric AI” in 2019³⁵, where the key requirements “Ethics Guidelines for Trustworthy Artificial Intelligence” are supported³⁶, which have been established by a high-level expert group formed by the Commission. These key requirements are:

- Human agency and oversight
- Technical robustness and safety
- Privacy and data governance
- Transparency
- Diversity, non-discrimination and fairness
- Societal and environmental well-being
- Accountability

Challenges that can be expected for society and individuals and that require preventive actions for a responsible AI development are the following:

- Although this type of problem has not yet been identified within Serbia, it is necessary to prevent discrimination based on machine learning. Comparative practice has shown cases of unintended discrimination which can have considerable consequences for citizens. This is especially valid for artificial intelligence developed for the improvement of public services. For example, a system may be introduced that determines the level of risk of individuals committing a breach or crime. If the used data is not adequately reviewed, such a system might reproduce a discriminative pattern.
- There are no clear mechanisms to determine whether a particular artificial intelligence solution has met all the necessary requirements to be applied to a large number of users and whether it has been developed in such a way that the data used for training the model or its application is adequate, representative enough and protecting the personal data of citizens.
- The sudden increase of artificial intelligence implementation requires a responsible and inclusive development of artificial intelligence for the whole society and consequently the

³⁴General Data Protection Regulation (EU) 2016/679, <https://eur-lex.europa.eu/eli/reg/2016/679/oj>

³⁵Building Trust in Human-Centric Artificial Intelligence, COM(2019) 168 final, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2019:0168:FIN>

³⁶Ethics Guidelines for Trustworthy AI, <https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai>

compliance with international guidelines, practice and regulations is indispensable and the implementation of these principles in practice must be guaranteed.

5 What we want to achieve

Artificial intelligence is a factor that will globally cause significant changes in everyday life, work and business during the upcoming years. Serbia will be among the countries using the challenge of artificial intelligence as an opportunity for progress.

Consequently, we want to achieve that in Serbia:

1. the education system, among others, develops the competencies for future needs of the job market, referring to professions directly connected with artificial intelligence and all other professions changing under the influence of artificial intelligence, which become more or less necessary or which didn't even exist earlier;
2. the business sector successfully adapts to new working models and new market expectations accompanied by a strong development of business entities whose business is based on the use of artificial intelligence;
3. the development of scientific research activities significantly contributes to the emergence of highly competent experts in the field of artificial intelligence and its implementations, while research results contribute to the development of the business sector;
4. the legal regulation is in all fields adapted to the new circumstances brought about by artificial intelligence, the requirements of new business models and product developments and services based on artificial intelligence, while taking into account the protection against potential negative effects.
5. There is a comprehensive understanding of ethical aspects while planning, designing and implementing solutions in the field of artificial intelligence from a perspective of technical characteristics as well as from a perspective of effects of implementation, while taking into account the principles of preserving the freedom of individuals, fairness and equality, avoidance of damage, openness, transparency and sustainability.

6 Strategy objectives

The general objective of the strategy is the use of artificial intelligence in favor of economic growth, employment and improvement of the quality of life.

Special objectives of the strategy are:

1. Development of education geared to the needs of modern society and economy conditioned by the advancement of artificial intelligence.
2. Development of science and innovation in the field of artificial intelligence and its implementation
3. Development of the economy based on artificial intelligence (where this is a key competence and where it is used in different industrial branches)

4. Improvement of assumptions for the development of artificial intelligence and public sector services through the implementation of artificial intelligence
5. Ethical and safe application of artificial intelligence

6.1 Specific objective 1: Development of education geared to the needs of modern society and economy conditioned by the advancement of artificial intelligence.

Education (formal and informal) is the basic means of human resources development in a certain field.

Besides the field of artificial intelligence and its implementation, education needs to respond to broader changes in society and business as a consequence of the global progress of artificial intelligence. Even if it is not possible to anticipate the future development of the job market at the level of individual jobs, there are trends that can serve as indicators:

- Increasing multidisciplinary in relation to classical divisions of professions and areas of competence, and in particular the linking of knowledge and skills in the socio-humanistic and artistic fields with the knowledge and skills in the fields of natural sciences and mathematics as well as technical and technological sciences;
- Increasingly important and growing role of data which is to be perceived from the perspective of data-based inference and decision-making, personal data protection, data ownership, data openness, data sharing, value exploitation from data, cooperation based on data use and data as the fuel of artificial intelligence;
- Methods and means used in the modern professional practice are indicators for the direction of the development happening under the influence of artificial intelligence and other technologies, based on which, even if the effect on future professions cannot be precisely predicted, the gap between the material learned at school and the methods and means of modern practice in the respective field can be reduced;

6.1.1 Measure 1.1: Enhancement of teaching contents at primary and high schools in accordance with the requirements conditioned by the progress of artificial intelligence

In primary school, the broader context of work automation and data analysis needs to be observed, with an understanding of the difference between machine learning and algorithms completely designed by humans.

At high school, besides the aforementioned, the results and contents improving the qualification of pupils for the use of artificial intelligence in their future work or for the further acquaintance with artificial intelligence in future education need to be predicted in the framework of teaching topics focusing on information technologies, depending on the educational background.

In the framework of Standards of Cross-curricular Competencies for the final phase of high school education³⁷, Digital Competence is emphasized as special cross-curricular competence. Still, the role of artificial intelligence in cross-curricular competences needs to be determined.

³⁷ Standards in Education, Institute for the Valuation of Education Quality, <https://ceo.edu.rs/standardi-y-obrazovaњу/>

Special attention should be paid to multidisciplinary in all areas, as the trends of new professions, directly or indirectly influenced by the development of artificial intelligence, generally move towards multidisciplinary, compared to the professions inherited from the industrial age.

As the implementation of changes in the education system is complex and time-consuming, this measure should be implemented in two phases: in the short term, the activities that will kickstart and shape the process should be envisioned; in the long term, this will lead to actual changes in the programs of teaching and learning, and educational standards with an appropriate development of competency among the teachers and other factors that influence the capacity building within the educational system.

The development of teachers' competencies is the central link and main challenge for the implementation of this measure. All subjects need to be adjusted to the multidisciplinary approach, and this adjustment presupposes not only getting to know the concept of multidisciplinary, but also obtaining an elementary level of specific competencies in related fields, as well as competencies in modern methods in the original field that include multidisciplinary. Apart from multidisciplinary which is relevant for teachers of all subjects, the development of teachers' competencies in technology-oriented subjects will present a special challenge.

6.1.1.1 Institutions responsible for monitoring and control of implementation

1. Ministry of Education, Science and Technological Development
2. The Institute for the Improvement of Education
3. The Institute for the Valuation of Education Quality

6.1.1.2 Indicators

1. The number of primary school subjects where the teaching and learning program properly includes artificial intelligence compared to the target values defined in the first phase.

Initial value: 0

Target value for the end of 2022: 1

Target value for the end of 2025: 2

2. The number of subjects in high schools where the teaching and learning program properly includes artificial intelligence.

The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

3. The development of digital skills evaluated at the Global Competitiveness Index of the World Economic Forum.

Initial value: 4.2/7.0 (The Global Competitiveness Report 2018)

Target value for the end of 2022: 4.7/7.0 (The Global Competitiveness Report 2021)

Target value for the end of 2025: 5.4/7.0 (The Global Competitiveness Report 2024)

6.1.2 Measure 1.2: Establishment of minimal standards regarding the presence of artificial intelligence in basic studies in the area of computer science and computer engineering

Topics in the field of artificial intelligence have been present in undergraduate study programs in various ways and in different scope.

We would like this measure to establish certain minimal standards for the topics from the field of AI, which need to be taught within the appropriate required and optional subjects from the AI field in the study programs or modules of study programs oriented towards computer science, computer engineering, etc.

It is especially important for the topics in the field of AI which are taught as part of study programs to follow the questions and problems regarding AI which are current in the profession and are the basis for the current rise of artificial intelligence with the focus on advanced application of deep neural networks and ancillary technologies that allow this use. It is also necessary to include the topics in the field of the influence of AI development on society into appropriate courses.

The measure is supposed to anticipate the activities that will, in a consultative process, harmonize the standards, support the development of new study programs, i.e. study program modules in accordance with these standards, and stimulate the enrollment into study programs that meet the standards through the politics of determining the number of students who are funded from the budget of the Republic of Serbia.

6.1.2.1 Institutions responsible for monitoring and control of implementation

1. Ministry of Education, Science and Technological Development
2. Higher Education Institutions

6.1.2.2 Indicators

1. The total number of students accredited for enrollment into the first year of study programs that have been aligned with the minimum standards for artificial intelligence topics.
The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

6.1.3 Measure 1.3: Development of postgraduate study programs in the field of artificial intelligence

There is an increased need around the world for new machine learning engineers and scientific researchers who are capable of directly applying their knowledge to solve practical problems, as well as open problems related to artificial intelligence. This need is definitely present in the long-term development of artificial intelligence in Serbia as well. The introduction of the master program in artificial intelligence is already widely practiced at universities in the world, allowing graduates to contribute immediately to the development of artificial intelligence in their communities.

Good practice of creating programs in Serbia, in partnership with the business sector and non-governmental sector, was the competition for “Master 4.0” announced by the Ministry of Education, Science and Technological Development. The competition was open for HEIs with their suggestions for the master studies program. The implementation of the program was partially funded from the budget of the Republic, and partially by foreign companies. The program also included internships in companies, while lecturers from abroad participated in the implementation of the program. This type of competition could be implemented for all programs in the field of AI.

Apart from the master studies program oriented towards expert education for the needs of the industry, attractive PhD programs should also be developed in an attempt to keep successful students at universities in order to produce the next generation of great scientists.

These programs will help the students gain the latest knowledge in the field of AI, which will allow them to have excellent jobs in Serbia, as well as develop their own ideas in companies and scientific research institutions in Serbia.

6.1.3.1 Institutions responsible for monitoring and control of implementation:

1. Ministry of Education, Science and Technological Development

2. Higher Education Institutions

6.1.3.2 Indicators

1. The number of AI MA programs:

The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

2. The number of students in AI MA programs:

The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

3. The number of AI PhD programs:

The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

6.1.4 Measure 1.4: Development of professional training through short study programs and informal learning

Constant professional training is extremely important for all jobs in the IT sector, and in especially dynamic fields, such as AI, it is even more important. It is important to provide the possibility for existing experts in the field of IT and other experts with enough necessary prior knowledge to gain competencies for the application of modern machine learning methods.

It is necessary to plan and implement activities that will contribute to an increasing number of experts with appropriate prior knowledge of IT, mathematics and statistics gaining such competencies through programs of informal learning and short study programs. These can be programs that last from several months to a year, and which would train participants to work in teams that implement AI projects.

Short study programs, recently implemented in the higher education system, are realized with the purpose of professional training and, together with training programs that belong to informal learning, they represent forms of professional development by way of which this measure is realized.

Apart from programs that last for several months, the measure must include support for shorter forms of informal learning, such as seminars and thematic courses, especially if they contain the factor of AI popularization. This includes supporting the organization of expert conferences in the field of artificial intelligence application, with particular emphasis on conferences with an international character.

One of the forms of non-formal education are events that have a competitive character, where the problems are solved by using artificial intelligence. It is necessary to support the organization of such competitions, as well as the participation of individuals and teams from Serbia in international competitions.

There is a particular need to plan and implement activities that will contribute to educating the wider population about AI, including supporting educational programs aimed at the general population and developing freely available educational materials.

This measure may include activities that financially or otherwise support the implementation of training, development of new training programs and short study programs, attendance of training or short study programs, organization of conferences, etc.

It is recommended that higher education institutions analyze the possibilities for implementing short study programs in the field of AI, in accordance with market needs.

6.1.4.1 *Institutions responsible for monitoring and control of implementation*

1. Ministry of Labor, Employment, Veterans' and Social Affairs
2. Ministry of Education, Science and Technological Development
3. Higher Education Institutions

6.1.4.2 *Indicators*

1. The number of participants who finished trainings supported by this measure in the current year:
Initial value: 0
Target value for the end of 2022: 500
Target value for the end of 2025: 1000
2. The number of short study programs in the field of AI:
The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

6.1.5 Measure 1.5: Greater openness of universities for cooperation with the aim of implementing study programs in the field of artificial intelligence

Very dynamic development of artificial intelligence is accompanied by very large investments of companies in development projects, alongside attracting top experts who work in these companies and become more mature. On the other hand, companies cannot and do not attempt to take the role of universities in educating new professionals. This is why there is a clear interest for both sides for the cooperation between the business sector and the universities in planning and implementing study programs. However, successful models of cooperation are not easy to establish. One of the main issues is the manner in which experts from the business sector can participate without having academic rank for teaching purposes.

Apart from cooperation with the business sector, due to the multidisciplinary character of artificial intelligence use, it is necessary to expand the cooperation among the universities in planning and implementing study programs, as well as to allow students to gain their multidisciplinary competencies with an increased mobility between universities.

This measure should start from focusing on study programs of postgraduate studies, however, over time, the focus should expand to include undergraduate studies as well.

Activities included in this measure should help identify and remove any barriers to achieving better cooperation between the universities and the business sector, as well as among universities in implementing study programs in the field of artificial intelligence and the establishment of such cooperation should be supported and encouraged.

6.1.5.1 *Institutions responsible for monitoring and control of implementation*

1. Ministry of Education, Science and Technological Development
2. Higher Education Institutions

6.1.5.2 *Indicators*

1. The number of study programs in the field of artificial intelligence that have been planned and implemented in cooperation with the business sector.
The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

6.2 Specific objective 2: Development of science and innovation in the field of artificial intelligence and its implementation

The field of artificial intelligence is in the development phase where industry practice often meets problems whose solutions require the scientific research approach. As a result of this, an important part of research has moved to the industry. However, the industry also has an increasing need for universities and institutes, as the scientific research staff is still developed primarily in the academic surroundings.

6.2.1 Measure 2.1: Increasing the support level for the researchers in the field of artificial intelligence

The most important steps in the development of artificial intelligence were made in scientific research centers of the world's leading universities and IT companies. In order to have long-term scientific research in the field of artificial intelligence, it is necessary to continuously improve the level of support for researchers in this field. It is necessary to work on long-term, fundamental research, as well as the research that will bring about the application of innovations in cooperation with the business sector. The advantage of artificial intelligence is that it has the ability to improve many fields of research, such as medicine, agriculture, forestry, and economy. The support for multidisciplinary research means allowing all scientific fields to develop faster. It is necessary for increasing international cooperation in order to transfer knowledge and experience, as well as support the arrival of international experts who will transfer their knowledge and support research in the scientific research organizations in Serbia.

Given that in areas of extremely dynamic development, such as AI, conferences are gaining additional importance, it is necessary to support the participation of researchers from Serbia at the world's leading artificial intelligence conferences.

Apart from the support for individual research, it is necessary to provide support through services available to all researchers, such as increased presence of important published materials about artificial intelligence in the Serbian Library Consortium for Coordinated Acquisition (KoBSON).

6.2.1.1 *Institutions responsible for monitoring and control of implementation:*

1. Ministry of Education, Science and Technological Development
2. The Science Fund

6.2.1.2 *Indicators*

1. Number of publications by researchers from Serbia in the field of development and application of artificial intelligence published in renowned scientific publications, including prestigious international conferences
Initial value for 2018: 150 papers
Target value for 2022: 180 papers
Target value for the end of 2025: 230 papers
2. Funds invested in research institutions and research projects in the field of AI:
Initial value: € 2.4 million
Target value for the end of 2022: € 5 million
Target value for the end of 2025: € 6 million

6.2.2 Measure 2.2: Special support for research and innovations in the fields where there is a special potential for innovative use of artificial intelligence

Apart from the general support for researchers in the area of artificial intelligence, it is necessary to define the priority fields with exceptional potential of artificial intelligence application and provide special support for projects in those areas.

This measure should secure that the funds invested in research and the innovations are directed towards projects based on modern achievements in the field of artificial intelligence which are the reason why this strategy is implemented, instead of being squandered on all the projects that are in any way connected with AI. When defining priority fields, the following should be taken into consideration:

1. That modern artificial intelligence methods based on or related to the use of deep neural networks and associated scientific and technological developments are being used in an innovative manner;
2. The potential of data that are or that could be at Serbia's disposal;
3. Economic development potential, whether regarding the companies that operate in Serbia or as a way of attracting investments;
4. The importance of this industry branch and the potential effects in the industry branch, if the area of application is associated with a traditional industry branch;
5. Priorities that do not have to have an immediate economic effect, such as health, safety, language, culture, national infrastructure, public services, etc.;
6. In particular, areas that address issues with distinct specificities for Serbia should be addressed, the resolution of which is important for the wider application of artificial intelligence.

Within the activities for implementing this measure, there should be an additional clarification of priority fields, followed by clear invitations, i.e. topics within the project funding program, with the funds dedicated to these projects.

6.2.2.1 *Institutions responsible for monitoring and control of implementation*

1. Ministry of Education, Science and Technological Development
2. The Science Fund
3. Innovation Fund

6.2.2.2 *Indicators*

1. The number of projects and the funds allocated for the projects funded in tenders and topics that are related to priority fields of this measure
Initial value: 0
Target value for the end of 2022: 2
Target value for the end of 2025: 4
2. The number of patents in the field of artificial intelligence
The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

6.2.3 Measure 2.3: Establishing the cooperation of scientific research institutions, the business sector and the public sector in the innovative application of artificial intelligence

Due to dynamic development of artificial intelligence and its applications, the research and development market in the field of artificial intelligence on a global level has been shifted towards the industry. This, however, did not rule out the role of universities and institutes as scientific research institutions, but led to the need for new forms of cooperation between the scientific research institutions and the business sector, including the public sector in which domain there is an application area and where large data sets are contained.

Also, rapid production of scientific discoveries in this field will gain its true value only when research ideas turn into practical innovations that can further result in profitable business or improvement of public services. It is necessary to set up the entire cycle of innovations, from scientific research, via industry-lead research and development, to testing the innovation in a work environment. The support for multidisciplinary innovation projects dealing with the development and application of smart technologies, as well as the application of AI in the analysis of available data, would enable networking and the exchange of ideas between the scientists and the experts from the business and public sector.

The implementation of this measure should help secure support for joint projects of scientific research institutions, the business and the public sector in the field of artificial intelligence, while respecting the priority fields from measure 2.2. Apart from projects, the support can be extended to organizing conferences, gatherings and other activities that help establish collaboration.

In the spirit of the ecosystem that supports a successful transfer of technologies, it is necessary to secure specific support for starting and developing university spinoff companies.

6.2.3.1 *Institutions responsible for monitoring and control of implementation*

1. Ministry of Education, Science and Technological Development
2. The Science Fund
3. Innovation Fund

6.2.3.2 *Indicators*

1. The number of projects and the total value of projects supported by this measure
The initial and target values of the indicators will be determined in the framework of the implementation of the measure.
2. The number of university spinoff companies in the field of AI
The initial and target values of the indicators will be determined in the framework of the implementation of the measure.

6.2.4 Measure 2.4: Foundation of the Artificial Intelligence Institute

With the goal of monitoring the fast development of AI, good practice in other countries has proven to be the foundation of an Artificial Intelligence Institute. The institute would deal with research related to the application of artificial intelligence in different areas, with strong multidisciplinary approach and collaboration with scientific research institutions in the areas of application, with the business and public sectors.

The Institute would be founded and primarily funded from the budget of the Republic of Serbia, with additional support of the business sector and international organizations. The scope of work of the Institute would be accurately defined by the Ministry of Education, Science and Technological Development based on the proposal of the Artificial Intelligence Council.

Post-graduate students would perform research at the Institute, just like at other scientific research institutions.

Apart from scientific research projects, the Institute would be responsible for analyzing and monitoring the state of artificial intelligence in Serbia, as well as providing general support for adapting AI solutions for the Serbian language, together with the public and the business sectors.

The Institute would make the collaboration of these research groups much easier and would attract more students and trainees from other countries. Also, the Institute would be tasked to maintain strong contact with researchers in other countries who originate from Serbia, as well as the relevant foreign researchers.

The Institute would have at its disposal the most modern equipment, hardware and software necessary to conduct all these activities. The institute would participate in shaping public policies that deal with the development and use of AI, primarily when it comes to the influence on the individual and the society, with the goal of supporting the development of AI-based systems that protect human rights and liberties and contribute to the improvement of an individual and development of the society as a whole.

6.2.4.1 *Institutions responsible for monitoring and control of implementation*

1. Ministry of Education, Science and Technological Development
2. Artificial Intelligence Council

6.2.4.2 *Indicators*

1. The number of researchers employed at the Institute
Initial value: approximately 0
Target value for the end of 2022: to be determined
Target value for the end of 2025: 50
2. The number of MA and PhD papers mentored by the members of the Institute
Initial value: approximately 0
Target value for the end of 2025: 30
3. The number of started multidisciplinary research projects:
Initial value: approximately 0
Target value for the end of 2022: to be determined
Target value for the end of 2025: 10
4. The number of project in joint collaboration with the business sector
Initial value: approximately 0
Target value for the end of 2022: 5
Target value for the end of 2025: 10

6.3 Specific objective 3: Development of the economy based on artificial intelligence

One of the main questions when supporting the development of business entities in the field of artificial intelligence is the balance between supporting the development of startups and small companies and attracting investments by large companies. Companies in the field of artificial intelligence that operate in Serbia are rarely, if ever, market competitors in terms of products. However, they are competition at the job market where they are fighting for the same talented experts. This is why it is important that the measures regarding this goal do not provide unfair advantage to certain companies on the job market.

Human resources in the field of artificial intelligence are the key factor for the development of economy in this area. Apart from the development of human resources through education and participation in scientific research, they also develop through career. This is why, apart from the company's participation in macroeconomic indicators such as social product and export, it is important to take into consideration the influence on the competency of the experts that pass through the company. Many successful startups, for example, have been founded by experts who have previously been employed in other companies.

6.3.1 Measure 3.1: Support for startups and SMEs in the field of artificial intelligence

This measure takes into consideration the existing and planned measures and activities aimed at the development of the startup ecosystem in Serbia and it will include activities that especially contribute to the development of startup companies and SMEs in the field of artificial intelligence.

This measure should achieve the following:

1. Establishing mechanisms for continued communication, exchange of experiences and improvement of knowledge and collaboration of startup companies and SMEs in the field of artificial intelligence, as well as all the included stakeholders;
2. Providing training and expert services in business, economy, law and other areas to startup companies and SMEs in the field of artificial intelligence;
3. Allowing startup companies and SMEs in the field of artificial intelligence to use the technological infrastructure under favorable conditions, which primarily includes high-performance computer systems suitable for machine learning;
4. Promoting the advantages of the Serbian startup ecosystem in the field of artificial intelligence within the framework of international promotion;
5. Connecting startup companies and SMEs in the field of artificial intelligence with the institutions in the public sector that could be the source of data for machine learning projects;
6. Representation of domestic innovative solutions based on AI in public procurement.

Having in mind the goal of achieving all of the above, a technological park, an incubator specifically intended for users whose work is related to artificial intelligence, must exist.

6.3.1.1 *Institutions responsible for monitoring and control of implementation*

1. Ministry of Education, Science and Technological Development
2. Ministry of Economy
3. Innovation Fund
4. Public Procurement Office
5. Office for Information Technologies and eGovernment
6. Artificial Intelligence Institute

6.3.1.2 *Indicator*

1. The number of employees in companies that use the technological park, i.e. the incubator specifically intended for users working with artificial intelligence
Initial value: approximately 0
Target value for the end of 2022: 300
Target value for the end of 2025: to be determined

6.3.2 Measure 3.2: Raising the level of investment in the development of artificial intelligence

Development of new products and solutions based on the application of artificial intelligence can have very positive effects, whether measured financially or as benefits for the end user. However, such development often demands significant investment as it requires hiring highly expert staff, significant resources invested in gathering and preparation of data and, finally, high performance computers for learning deep neural networks. This is why projects in the field of artificial intelligence are often such that they demand a great investment before they deliver great results. This means that increasing the level of investment is one of the key factors for the development of artificial intelligence. Support for increasing the level of investment can be provided via the following:

1. Attracting the companies that develop AI to invest in their development capacities in Serbia;
2. Attracting risk capital for investment in companies in Serbia that develop AI;
3. Support to the investments in certain projects in the field of AI;
4. Higher representation of AI in public sector projects.

Support activities can also be provided via the following:

1. Programs of the Innovation Fund aimed at funding projects or innovation vouchers
2. Programs of the the Science Fund aimed at funding projects implemented by business sector organizations
3. Investment programs from public funds that are tied with the investments from the risk capital funds, relating to investments in the businesses based on the application of AI
4. Special AI category in the competition for the “Best Technological Innovation”
5. Planning of AI solutions procurement by the Office for Information Technologies and eGovernment

6.3.2.1 *Institutions responsible for monitoring and control of implementation*

1. Ministry of Education, Science and Technological Development
2. Ministry of Finance
3. Ministry of Economy
4. Office for Information Technologies and eGovernment
5. Innovation Fund
6. Export Credit and Insurance Agency

6.3.2.2 *Indicators*

1. The number of companies that have used the support under this measure and the total financial value of this support
The initial and target values of the indicators will be determined in the framework of the implementation of the measure.
2. Score in the “Procurement of advanced technological solutions and systems in public administration” category in the Networked Readiness Index of the World Economic Forum.
Initial value: 2.8/7.0
Target value for the end of 2022: 3.2/7.0
Target value for the end of 2025: 3.5/7.0
3. The number of startups in the field of artificial intelligence (registered on Crunchbase or similar platforms)
Initial value: approximately 4

Target value for the end of 2022: 15

Target value for the end of 2025: 25

4. The “Capacity for innovation in the private sector” indicator of the Global Competitiveness Index measuring the potential of the private sector to create innovative solutions through criteria such as the variety of workforce, potential for cluster development, cooperation of stakeholders, number of published scientific papers and patent registry applications, investment in research and development (R&D) etc.

Initial value: 39.7/100

Target value for the end of 2022: 45/100

Target value for the end of 2025: 55/100

6.3.3 Measure 3.3: Establishing the multi-sector development solution based on artificial intelligence in the areas of public interest

It is especially necessary to support the application of AI in the areas that are also important for life and economy and have the potential for artificial intelligence application. Four areas of public interest in which the application of artificial intelligence will be specifically and primarily supported are:

1. Health and medicine, with important possibility of applying artificial intelligence in diagnostics
2. Agriculture and forestry, where there is potential of artificial intelligence application in order to more accurately plan and reach decisions based on the collected data (accurate agriculture), as well as by using autonomous vehicles and machines
3. Transport, which includes autonomous vehicles and controlling the road infrastructure
4. Smart cities, which is the area that already includes the application of information technologies in order to have a more efficiently functioning urban environments and increase the quality of life in them, with an increasing number of possibilities for the use of artificial intelligence within the application of technology

The support for the projects of artificial intelligence application in the areas of public interest will be realized through activities planned in cooperation with the relevant ministries and local self-governments. This can include the instruments listed in measure 3.2 in combination with instruments specific to a certain department, such as, for example, subsidies in the field of agriculture and forestry for new machines and equipment.

Special support will be provided for connecting the universities and institutes, business and public sector in establishing innovative solutions of public interest.

6.3.3.1 *Institutions responsible for monitoring and control of implementation:*

1. Ministry of Education, Science and Technological Development
2. Ministry of Health
3. Ministry of Agriculture, Forestry and Water Management
4. Ministry of Construction, Transport and Infrastructure
5. Ministry of Trade, Tourism and Telecommunications
6. Ministry of Public Administration and Local Self-Government
7. Local self-governments
8. Office for Information Technologies and eGovernment
9. Innovation Fund
10. Export Credit and Insurance Agency

6.3.3.2 *Indicator*

1. The number of developed and applicable solutions of public interest based on artificial intelligence
Initial value: approximately 0
Target value for the end of 2022: 2
Target value for the end of 2025: 4

6.3.4 Measure 3.4: Continuous analysis and monitoring of the state of artificial intelligence

Artificial intelligence appears in activities of various companies, and it is necessary to establish continued analysis and tracking of the state of this field in order to have a clearer image about how many companies, with what resources and in which manner are working with artificial intelligence.

Within this measure, the necessary data for the needs of tracking the state of this field will be gathered as obligatory data, through questionnaires that business entities fill in and deliver to the Statistics Office of the Republic of Serbia for the needs of official statistical research. This data includes the data on whether a business entity is using artificial intelligence within its business operations (as support in realizing a business activity), data regarding whether it develops products based on artificial intelligence and which exact methods are applied. Data will also be gathered from the Intellectual Property Office of the Republic of Serbia regarding the number of patents that include AI and in which area. Another set of data will be gathered declaratively, by making it possible for the private sector, public administration and universities declare the projects they are working on and the techniques they are using when developing artificial intelligence through the technological park.

Apart from this, as there is currently no data regarding the contribution of artificial intelligence with regard to the economic indicators of the state of the economy, while the strategy is being carried out, the best way to gather and regularly publish official data regarding this contribution will be published and implemented in practice in order to enable a well-informed strategic development of artificial intelligence.

6.3.4.1 *Institutions responsible for monitoring and control of implementation*

1. Artificial Intelligence Council
2. Artificial Intelligence Institute
3. Science Technology Park Belgrade
4. Statistics Office of the Republic of Serbia
5. Office for Information Technologies and eGovernment
6. Intellectual Property Office of the Republic of Serbia

6.3.4.2 *Indicators*

1. Availability of data on companies in the field of artificial intelligence on the portal of the Statistics Office of the Republic of Serbia
Initial value: approximately 0 indicators
Target value for the end of 2022: At least 2 developed indicators being continually monitored
Target value for the end of 2025: At least 4 developed indicators being continually monitored
2. The established indicators and regular annual reporting and monitoring of the economic benefit of the products based on artificial intelligence within annual economic indicators
Initial value: 0 reports

Target value for the end of 2022: 3 reports

Target value for the end of 2025: 5 reports

6.3.5 Measure 3.5: Introduction of the “regulatory sandbox” limited network exception established to test AI-based solutions

It is necessary to establish more flexible regulatory frameworks in certain limited markets and areas so that the innovative solutions and business models based on artificial intelligence could be tested under certain controlled conditions. Such frameworks are called *regulatory sandbox* and represent the frame for the introduction of the Institute that enables the testing of innovative solutions without administrative burdens or the need to obtain licenses. At least two such frameworks have been introduced in Serbia. The first one was introduced by the National Bank of Serbia regarding payment services, which enabled the testing of innovative solutions without obtaining licenses under certain conditions and for a limited number of users. The second example was introduced by the Medicines and Medical Devices Agency of Serbia in the field of health, which enabled a 24-hour approval for importing unregistered medical devices for the needs of research and development under certain conditions (e.g. for certain faculties, institutes or portfolio companies of the Innovation Fund).

In order to develop artificial intelligence, there is a need for at least two more regulatory sandbox frameworks in the fields where it is possible to test artificial intelligence and develop innovations. Fields where this will be established will be identified in the Action Plan.

6.3.5.1 *Institution responsible for monitoring and control of implementation:*

1. Artificial Intelligence Council
2. Artificial Intelligence Institute
3. Relevant ministries responsible for the regulatory area where “Regulatory sandbox” is permitted

6.3.5.2 *Indicator*

1. Additional “Regulatory sandbox” limited network exceptions established to test AI-based solutions

Initial value: 2

Target value for the end of 2022: 3

Target value for the end of 2025: 5

6.4 Specific objective 4: Improvement of assumptions for the development of artificial intelligence and public sector services through the implementation of artificial intelligence

To this end, measures are planned to establish an adequate framework for strategic management, coordination and monitoring of the development and implementation of artificial intelligence in the Republic of Serbia, development of infrastructure assumptions and provision of data as resources, and use of artificial intelligence to improve the efficiency and quality of services that the public sector provides to the citizens, the economy and the state.

6.4.1 Measure 4.1 Establishment of the Artificial Intelligence Council

The establishment of the Artificial Intelligence Council for a period of 5 years as a temporary working body of the Government, which would, aside from the representatives of state authorities and the academia, also include the representatives of stakeholders and participants in the development of artificial intelligence from the private sector and civil society organizations. The

Artificial Intelligence Council should adjust and coordinate activities for the implementation of the strategic framework in the field of artificial intelligence development, monitor the implementation of planned measures and activities, including this strategy, and monitor the state, needs and standards of development and use of artificial intelligence in Serbia and worldwide. The working body also has an advisory role and prepares proposals, recommendations and standards, provides opinions and expert explanations on all issues related to the development and use of artificial intelligence in the Republic of Serbia.

6.4.1.1 *Institution responsible for monitoring and control of implementation*

1. Ministry of Education, Science and Technological Development

6.4.1.2 *Indicators*

1. Number of issued reports on the state of artificial intelligence and the implementation of strategic documents

Verification source: Council meeting minutes

Initial value: 0

Target value for the end of 2022: 6

Target value for the end of 2025: 12

6.4.2 Measure 4.2 Opening and reusing public sector data relevant for the development of artificial intelligence

During consultations, the data on company business operations, taxation, as well as data on healthcare and transport were preliminary defined as priority for the opening, but it is necessary to determine more precisely the priority datasets for opening, to conduct a feasibility analysis for their opening in short (annual) or medium term (2-3 years) and develop action plans for the opening of those priority datasets that are relevant for the development of artificial intelligence.

If the conducted analysis results in the identification of such areas where data collection mechanisms have yet to be provided, the legal, organizational and technical framework for their collection and publishing needs to be defined and, where appropriate, some alternative mechanisms should be foreseen and implemented.

Given that in the period from 2016 to 2018 all the key elements of the national initiative for the opening of institution data (Open Data Workgroup, Open Data Portal, the legal framework) were set up in the Republic of Serbia, as well as the fact that the proposal for a strategic framework – eGovernment Development Program from 2019 to 2022 already planned for a series of measures and activities aimed at providing a large number of datasets and improving the quality of open data of institutions, it is necessary to ensure that the opening of data relevant for the development of artificial intelligence is in line with the existing national initiative, i.e. to ensure the opening of those reusable datasets that have a specific use value for the development of artificial intelligence.

In addition to the activities of the national initiative for public sector data opening aimed at publishing datasets on the Open Data Portal so far, the development of artificial intelligence requires for additional activities to be carried out in order to ensure the reuse of data that is not open to everyone nor is the access to it free of charge, but is necessary for both scientific research and commercial projects in the field of artificial intelligence development. The public sector needs to recognize the commercial value of its data and improve its capacity to collect, annotate and provide access to it, because aside from additional revenues for the public sector, the reuse of data enables the development of scientific research and the creation of added value for the economy and the society as a whole.

Within this measure, an analysis of the legal ownership of the data and the improvement of the legal framework regarding the data-as-property are required as a prerequisite. It is necessary to

evaluate the existing rules of real and contract law, intellectual property rights and other legal areas in order to provide conditions for the development of research and innovation and to provide legal certainty in this area.

Upon the formation of the Artificial Intelligence Council, ongoing communication, coordination and cooperation with the Office for Information Technologies and eGovernment as a Government office that institutionally manages the institutions' data-opening initiative, as well as with the Open Data Working Group should be ensured.

6.4.2.1 *Institution responsible for monitoring and control of implementation*

1. Office for Information Technologies and eGovernment

6.4.2.2 *Indicators*

1. Number of open datasets relevant for artificial intelligence development.

Verification source: National Open Data Portal

Initial value: 0

Target value for the end of 2022: 150

Target value for the end of 2025: 1000

6.4.3 Measure 4.3 Development of mechanisms for the reuse of private sector data relevant for the development of artificial intelligence

The measure is aimed at creating opportunities for the reuse of data held by the private sector for the needs of public and private artificial intelligence development projects. Bearing in mind the diversity of data types and business interests of companies, as well as the absence of a legal obligation to open, i.e. provide access to private sector data, comparative practice reflects the impossibility of uniquely establishing a model for the reuse of this data, i.e. the need to take a flexible approach.

It is planned to conduct an analysis to identify datasets owned by the private sector that have a use value for the development of artificial intelligence and try to provide the reuse of such datasets. After conducting the feasibility analysis for the opening of such datasets in the short (annual) or medium term (2-3 years), it is necessary to formulate annual activity plans and specific mechanisms and models for enabling the reuse of specific datasets and the affirmation of the concept of providing access to private sector data for reuse. Potential incentives such as rewards or tax benefits for companies that are opening, i.e. providing access to their data should also be analyzed.

It is also planned to conduct an analysis of the need to provide a separate infrastructure for the opening and sharing of private sector data together with a solution proposal for its maintenance, storage and annotation, or the possibility of establishing a catalog of available private sector datasets.

The practice of donating data for reuse as a form of corporate responsibility should be established and promoted. Donating may entail the opening of data according to the open data model of institutions, i.e. in some cases, the data may be made available to an unlimited number of potential users free of charge. In other cases, it is possible to donate data for the purposes of public sector projects in the public interest or of a particular private sector artificial intelligence development project. Data opening can also be realized through open data "challenges" in the form of public calls for the creation of socially useful solutions.

The obligation of opening or providing data can be ensured during public procurements, especially when private companies are entrusted with certain tasks of public importance such as construction of infrastructure, utilities, public transport, etc. In such cases, it is possible for the Public Procurement Law to establish an obligation for tenderers to make the data available to the

contracting authority without restriction that the contracting authority must make it further available. It is necessary to apply the same principle in the case of granting concessions and work licenses.

In comparative practice, there are more and more examples of data sharing partnerships, as well as data monetization, that is, establishing a data market or providing access to services based on company data through closed platforms or with third party mediation. These types of data reuse enabling should also be supported, as well as the establishment of sectoral or guild platforms (e.g. agricultural producers' platforms).

6.4.3.1 Institutions responsible for monitoring and control of implementation:

1. Office for Information Technologies and eGovernment
2. Artificial Intelligence Council

6.4.3.2 Indicators

1. Percentage of implementation of the annual plan for the reuse of private sector data
Verification source: Annual plans for the reuse of private sector data
Initial value: 0%
Target value for the end of 2022: 80%
Target value for the end of 2025: 100%
2. Number of companies from the Artificial Intelligence Council that gave permission for public access to their datasets
Initial value: 0
Target value for the end of 2022: At least 50% of companies shared at least 2 datasets
Target value for the end of 2025: At least 85% of companies shared at least 3 datasets

6.4.4 Measure 4.4 Establishment of shared infrastructure resources for artificial intelligence development

As pointed out in the analysis of the situation, the development of artificial intelligence solutions is based on computationally demanding processes of training multilayer neural networks using large datasets. The computational infrastructure required for these activities is often very expensive and not easily accessible. Therefore, the development of artificial intelligence in Serbia requires the provision of compute-intensive hardware infrastructure and software platform for artificial intelligence, which would be available to scientific research organizations, universities, as well as small and medium-sized enterprises and startups that are unable to provide these resources themselves. Establishing shared hardware and software infrastructure resources for the development of artificial intelligence would help the entire scientific and expert community in the Republic of Serbia to develop these solutions more efficiently.

The measure includes the creation of a National Artificial Intelligence Platform consisting of a state-of-the-art high performance computing system, together with a software platform for artificial intelligence and making this platform accessible to the academia, science and technology parks, public administration, and the economy for the development of innovative solutions.

The plan is for the National Artificial Intelligence Platform, managed by the Office of Information Technologies and eGovernment, to be located in the National Data Centers (Kragujevac and/or Belgrade) and be available upon request to certain institutions or the economy.

6.4.4.1 Institution responsible for monitoring and control of implementation:

1. Office for Information Technologies and eGovernment

6.4.4.2 Indicators

1. Number of sites for accessing the National Artificial Intelligence Platform

Verification source: Annual report of the Artificial Intelligence Council

Initial value: 0

Target value for the end of 2022: 50

Target value for the end of 2025: 100

6.4.5 Measure 4.5 Improvement of public sector services using artificial intelligence

Given the great potential of using artificial intelligence in the public sector, implementation of projects for public sector services improvement is planned. In the context of accelerated public administration work digitization, infrastructure development and the provision of interoperability as necessary preconditions for the development of e-services, the implementation of artificial intelligence solutions in the process of data cleansing and updating can significantly contribute to improving the quality of data in public administration registers and e-records (Central Population Register, business registers, Real Estate Cadaster, Address Register, registers in the education, healthcare, tourism, social welfare systems, etc.). Artificial intelligence can give a special contribution in the process of analyzing large amounts of data generated by the digitization of public administration, with the aim of improving the efficiency, cost-effectiveness and transparency of public administration work. For example, risk analysis for inspections through upgrading of the eInspector system.

The implementation of solutions based on machine learning, deep learning and processing large amounts of data has huge potential for improving the services that public administration provides to citizens, the economy and the state, but also for performance optimization and the improvement of services of all other systems within the public sector.

In the healthcare system, artificial intelligence can significantly improve early diagnostics, ensure better availability of all resources and equipment and optimize their use, as well as contribute to the improvement of the quality and efficiency of health services.

The use of artificial intelligence in the field of transport can significantly improve traffic flow and mobility in urban areas and optimize traffic signaling through real-time traffic management.

6.4.5.1 *Institution responsible for monitoring and control of implementation*

Office for Information Technologies and eGovernment

6.4.5.2 *Indicators*

1. Number of implemented projects for the improvement of public sector services using artificial intelligence

Verification source: Annual report of the Artificial Intelligence Council

Initial value: 1

Target value for the end of 2022: 3

Target value for the end of 2025: 20

2. The “Importance of innovations and technology for the future” indicator from the WEF Networked Readiness Index assesses the level of innovations and aspirations to use new technologies as an integrative element of public policies in the future and it is measured on the basis of the management’s plans to use information technology to increase competitiveness.

Initial value: 3.2/7.0

Target value for the end of 2022: 3.5/7.0

Target value for the end of 2025: 4.0/7.0

6.5 Specific objective 5: Ethical and safe application of artificial intelligence

The application of artificial intelligence opens up a number of ethical and safety challenges that need to be addressed and prevented. Many other countries are faced with the same challenges,

so international standards should also be taken into account. Ethics and safety in the development of artificial intelligence should be ensured primarily with regard to the protection of personal data, the protection against discrimination when using machine learning, and the establishment of responsible artificial intelligence development in accordance with international ethical principles. The goal is to introduce prevention mechanisms that will allow for the responsible development of artificial intelligence and methods of verifying that systems based on machine learning are in compliance with the highest ethical and safety standards.

6.5.1 Measure 5.1: Personal data protection in the field of artificial intelligence

Artificial intelligence raises specific questions about the protection of personal data, both for data used for machine learning and for data processed using artificial intelligence. It is necessary to ensure that personal data is protected during the development phase of solutions based on artificial intelligence (data used for “training”) and data that is post-processed through an already trained system that uses new data.

Within this measure, the key focus will be on developing an activity plan and implementing a practical diagram of the steps that must be taken to protect personal data in the development of solutions based on artificial intelligence that will be used equally across all sectors of society (the private sector, state administration and universities). In addition, certification of products and solutions based on artificial intelligence will be established to ensure the protection of personal data and compliance with international ethical standards. It is necessary to define and develop a certification program for solutions a) established by public authorities and b) the private sector, which will provide safety and ensure public confidence that the developed solutions are in accordance with the regulations for the protection of personal data.

6.5.1.1 *Institutions responsible for monitoring and control of implementation:*

1. Ministry of Justice
2. Confidant for personal data protection
3. Office for Information Technologies and eGovernment

6.5.1.2 *Indicators*

1. The number of companies implementing the scheme for step-by-step artificial intelligence development in order to ensure personal data protection.

Initial value: 0

Target value for the end of 2022: 25

Target value for the end of 2025: 50

2. The number of certified solutions based on machine learning, whose compliance with regulations on personal data protection and internationally accepted ethical standards is confirmed.

Initial value: 0

Target value for the end of 2022: 25

Target value for the end of 2025: 50

6.5.2 Measure 5.2: Protection from discrimination in the implementation of artificial intelligence

The automation of decision-making using artificial intelligence, or of the analyses that influence decision-making, involves the risk of including criteria which are discriminatory by nature. The data used for training algorithms can be based on past discrimination (e.g. women have been

higher risk taxpayers in the past and the algorithm forecasts the same situation in the future), there can be unbalanced data (e.g. significantly more data for men than for women causing the algorithm to favor men afterwards), or the responsible person fails at including all relevant data sources in the training. In addition, individuals who are subject to the decisions made by the AI model must have the right to an explanation and the right to transparency in connection with the algorithm. That is why it is necessary to enable: prevention of discrimination, enable early understanding and interpretation of the model and enable explanation of the decision.

The ethical implementation of artificial intelligence should prevent the social exclusion of vulnerable social groups, the marginalization and discrimination of members of these groups like old persons, disabled persons, groups with the risk of multiple discrimination and others. Even if discrimination is not a new category, it can become systemic if it is established via machine learning, which is a risk that needs to be prevented.

In order to achieve this, technical and non-technical methods for ensuring the protection from discrimination need to be established in the implementation of artificial intelligence, namely:

1. Establishment of a set of practical ethical guidelines compliant with the Ethical Code which must be observed by all persons training algorithms and which include the recommendation that the team working on the development of artificial intelligence should be as diverse and representative as possible in order to prevent discrimination;
2. Organization of educational workshops with technical and non-technical personnel working on the development of artificial intelligence as primary target group in order to prevent discrimination;
3. Organization of competitions in the framework of which control and tool systems will be developed that can be used by the industry as preventive mechanisms in order to prevent the use of bias and discriminatory data characteristics for algorithm trainings;
4. Regulation of the discrimination prohibition in cases where discrimination occurs as a result of automated decision-making or assistance in decision-making, and clear definition of responsibilities in cases where machine learning leads to discrimination;
5. Establishment of the regulatory obligation that the data types used by machine learning for decision-making or assistance in decision-making are transparent and based on clear and simple schedules.

6.5.2.1 *Institutions responsible for monitoring and control of implementation:*

1. Artificial Intelligence Council
2. Confidant for equality protection
3. Ombudsman
4. Office for Information Technologies and eGovernment
5. Office for Human and Minority Rights

6.5.2.2 *Indicators*

1. Amendments to the law governing the prohibition of discrimination so that discrimination resulting from the use of artificial intelligence/ML is recognized
Initial value: No (0)
Target value for the end of 2022: No (0)
Target value for the end of 2025: Yes (1)
2. The number of executed training sessions for the prevention of discrimination in machine learning for technical and non-technical persons
Initial value: 0
Target value for the end of 2022: 200

Target value for the end of 2025: 500

6.5.3 Measure 5.3: Provision of responsible development of artificial intelligence in compliance with international ethical standards

Considering the fact that artificial intelligence is a highly progressive technology with a reach and effect on society that is not fully known so far and cannot completely be foreseen, it is important to actively work on creating an environment that will, on the one hand, ensure the trust of the public, and on the other hand enable the creation of new opportunities for AI development and implementation. The key objective is to find a balance between the support of AI development and implementation and responsible AI development based on basic ethical principles. In this sense, the development of an ethical framework should enable the protection of basic human rights and common values, but it should also serve the further development of AI through the creation of new opportunities for the improvement of individual lives and the progress of the whole society. To achieve this, it is necessary to:

1. Issue national ethical guidelines based on the *Ethics Guidelines for Trustworthy Artificial Intelligence* created by the Expert Group appointed by the European Commission in April, 2019. The document would first define an ethical framework, i.e. key values for a further development and implementation of AI, and subsequently it would establish clear guidelines for all stakeholders: entities developing AI systems, system users, the whole society. The basic principles of said document will include the implementation of the AI system in support of the development of a democratic and just society, for the purpose of protecting basic human rights and enable human supervision. One of the key components for the establishment of a reliable AI system is technical robustness requiring a system development with a preventive approach to risks. This includes the predictability of the behavior of systems based on AI, the reduction of unintended and unexpected damages, and the prevention of unacceptable damages like the protection from abuse of private data of individuals, from discrimination of individuals and groups, and so on.
2. It is necessary to ensure the principle of transparency for the elements relevant for AI systems – data, systems and applied business models. Sustainability and ecological responsibility of AI systems must be encouraged as well as research on the implementation of AI solutions dealing with fields of global significance like the Sustainable Development Goals. It is necessary to establish mechanisms ensuring the responsibility of AI systems, before and after their development, launch and implementation.
3. Based on ethical guidelines and international practice, an analysis of the compliance with the existing legal regulations needs to be conducted and the needs for amendments to the existing regulation or the issuance of a new one must be pointed out in order to address challenges, but also to encourage socially responsible AI development. It is crucial to conduct this analysis via an inclusive dialogue, as it must equally represent the interests of all stakeholders and be compliant with the best examples of international practice.
4. Encourage public dialogue in the form of organizing workshops, seminars, lectures and the like directed at the broad public in order to present benefits, but also highlighting the challenges emerging from the development and implementation of AI. It is crucial to build trust in AI implementation through dialogue and to encourage the social responsibility of the public and private sector for transforming challenges brought about by AI into new opportunities for the development of individuals and the society as a whole.

6.5.3.1 Institutions responsible for monitoring and control of implementation

1. Artificial Intelligence Council

2. Artificial Intelligence Institute
3. Ministry of Education, Science and Technological Development

6.5.3.2 Indicators

1. Adopted ethical guidelines for the development and use of artificial intelligence
Initial value: No (0)
Target value for the end of 2022: Yes (1)
Target value for the end of 2025: Yes (1)
2. Conducted analysis of the compliance of existing legislation with international practice and recommendations for further compliance and adoption of new legislation based on ethical guidelines
Initial value: No (0)
Target value for the end of 2022: Yes (1)
Target value for the end of 2025: Yes (1)
3. Established public dialogue to build trust in AI and identify new opportunities for the development of individuals and the society as a whole: the number of entities participating in the dialogue through various events
Initial value: approximately 50
Target value for the end of 2022: 500
Target value for the end of 2025: 1000

6.5a Indicators for the general and specific objectives of the Strategy

Indicator for the general objective of the Strategy

This indicator is the total degree of fulfilment of all specific objectives as percentage value determined based on indicators for each of the specific objectives.

- Initial value: 0%
- Target value for the end of 2025: 100%

Indicators for specific objectives of the Strategy

Specific objective 1:

The indicator for this specific objective is the total degree of fulfilment of all measures of this objective as percentage value determined based on indicators for each of the measures.

- Initial value: 0%
- Target value for the end of 2025: 100%

Specific objective 2:

The indicator for this specific objective is the total degree of fulfilment of all measures of this objective as percentage value determined based on indicators for each of the measures.

- Initial value: 0%
- Target value for the end of 2025: 100%

Specific objective 3:

The indicator for this specific objective is the total degree of fulfillment of all measures of this objective as percentage value determined based on indicators for each of the measures.

- Initial value: 0%
- Target value for the end of 2025: 100%

Specific objective 4:

The indicator for this specific objective is the total degree of fulfillment of all measures of this objective as percentage value determined based on indicators for each of the measures.

- Initial value: 0%
- Target value for the end of 2025: 100%

Specific objective 5:

The indicator for this specific objective is the total degree of fulfillment of all measures of this objective as percentage value determined based on indicators for each of the measures.

- Initial value: 0%
- Target value for the end of 2025: 100%

7 Held consultations

The cooperation and consulting processes are carried out in compliance with the Law on the Planning System of the Republic of Serbia ("Official Gazette of the RS", No. 30/18), Article 34 of the Law prescribing that during the creation of public policy documents, the contribution of stakeholders and target groups among business entities, expert and other organizations, as well as the representatives of state authorities and other participants in the planning system who implement themselves, or in relation to whom the policy is implemented must be ensured.

Accordingly, the Strategy preparation followed the consultative cooperation with relevant representatives of responsible ministries, authorities and organizations, the business sector, faculties, and the NGO sector. At the beginning stages of preparation of the Strategy for the Development of Artificial Intelligence, a Workgroup was formed in October 2019, composed of representatives of the Prime Minister's Office, ministries (Ministry of Education, Science and Technological Development, Ministry of Economy, Ministry of Trade, Tourism and Telecommunications, Ministry of Finance, Office of the Minister without portfolio in charge of innovation and technological development), institutions (Office for Information Technologies and eGovernment, the Science Fund of the Republic of Serbia, Science and Technology Park Belgrade), representatives of the University of Belgrade (Faculty of Electrical Engineering, Faculty of Mathematics, Faculty of Mechanical Engineering, Faculty of Organizational Sciences, Teacher Education Faculty, Mihajlo Pupin Institute), University of Novi Sad (Faculty of Technical Sciences), University of Kragujevac (Faculty of Natural Sciences and Mathematics), and University of Niš (Faculty of Electronic Engineering), industry representatives engaged in the development and use of artificial intelligence, as well as representatives of the Vojvodina ICT Cluster, the Petlja Foundation, the Serbian Chamber of Commerce, and the World Bank.

During the consultations, several focus groups took place according to the type of stakeholder: The first focus group was held with representatives of the business sector, outlining the key problems, the current view of the state of artificial intelligence in Serbia and suggestions and ideas for moving forward. The second focus group was held with representatives of the faculties and

institutes at which problems, the current state of the study and application of artificial intelligence were presented, as well as an overview of the subjects at the faculties at which the artificial intelligence is taught or applied. The third focus group was held with representatives of relevant ministries, authorities and organizations – Office for Information Technologies and eGovernment. The group addressed the current status of e-government, potential for the development of artificial intelligence in administration and opportunities and needs for support concerning a shared infrastructure and other benefits for startups dealing with artificial intelligence.

With the support of the World Bank, a one-day workshop was organized at the end of October, which dealt with the key guidelines, the direction, vision and objectives of the Strategy. It was concluded that Serbia needs to focus on the development of artificial intelligence in certain sectors that are of priority when it comes to economic development.

In several cycles, the members of the Workgroup gave comments and made suggestions for the working draft. While working on the formulation of measures, the members of the workgroup submitted over 85 written comments with proposals and descriptions of measures. The proposals were then processed, grouped and mostly integrated in the Strategy text. Afterwards, the document was submitted for commenting again. Proposals representing more of an activity were saved and they will be considered when composing the Action Plan.

8 Conducted public debate

Public debate on the Draft Strategy for the Development of Artificial Intelligence in the Republic of Serbia for the period 2020-2025 was opened from November 28 to December 18. As part of the public debate, three panels were held to discuss the draft with the interested public, namely:

- In Novi Sad, on December 4, at 11 am in the Chamber of Commerce of Vojvodina
- In Nis, on December 5, at 3 pm at the Startup Center at the Faculty of Electronic Engineering
- In Belgrade, on December 10, at 3 pm in the Science and Technology Park Belgrade

During the public debate, 12 letters with proposals and suggestions were received in writing, through a contact and email address, many of which were included in this text.

9 Strategy implementation monitoring method

The Ministry of Education, Science and Technological Development will inform the Artificial Intelligence Council twice a year about the realization of objectives and strategic measures envisaged by this Strategy, while the Artificial Intelligence Council informs the Government of the Republic of Serbia once a year about the status of implementation, as well as potential opportunities or risks for implementation.

Through the Information System for Planning, Implementation Monitoring, Public Policy Coordination and Reporting, the Ministry of Education, Science and Technological Development and the Artificial Intelligence Council will establish cooperation with responsible ministries, authorities and organizations, the business sector and faculties at a national and local level.

The three-year Action Plans for implementation and reports on the implementation of this Strategy will be issued by the Ministry of Education, Science and Technological Development in cooperation with the Artificial Intelligence Council, responsible ministries, authorities and organizations, the business sector, and faculties. The first three-year Action Plan for implementation of the Strategy for the Development of Artificial Intelligence will be adopted within 90 days from the

adoption of the Strategy. All other Action Plans will be issued in accordance with Article 18 paragraph 7 of the Law on the Planning System of the Republic of Serbia.