

CURRENT STATE AND ISSUES REGARDING THE DEVELOPMENT AND APPLICATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN BULGARIA

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Abstract

This study examines the application and development of artificial intelligence (AI) technologies in Bulgaria's information technology sector. Drawing on a substantial body of up-to-date data from national and European institutional studies, it highlights several positive facts, achievements, and trends in this sector, which plays a significant role in the Bulgarian economy. The findings indicate that Bulgaria has steadily established itself as a regional leader in Southeastern Europe. Many technology companies in the country are now successfully creating and implementing products not only for global markets but also for specific niche markets. As a result, this rapidly developing knowledge-based economy has become an essential component of Bulgaria's national economy.

At the same time, the study notes that the country faces several challenges that require appropriate solutions. To address these issues, the research proposes implementing specific measures to build the necessary institutional and legal framework, optimise investment attraction policies, improve the business environment, reform the education system, and develop modern communication and research infrastructure to support next-generation digital technologies.

The resolution of these challenges must be pursued systematically and consistently through the concerted efforts of society as a whole. In this way, Bulgaria can achieve the necessary scientific, expert, business, and managerial capacity to maintain its leading position in the development of artificial intelligence technologies within the context of global technological progress.

Keywords: Artificial Intelligence, information technologies, innovation, AI Factory, digital environment

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Introduction

In recent years, Bulgaria's information technology (IT) sector has made significant progress, driven by the increasing adoption of artificial intelligence (AI) technologies. The country has convincingly demonstrated notable advancement and accelerated development of a Bulgarian ecosystem centred on scientific communities, innovative entrepreneurs, investors, large corporations, and government organisations. This type of ecosystem is based on collaboration between researchers conducting both fundamental and applied studies, as well as developers and users of intelligent systems. It fosters a dynamic business environment that supports technology startups and attracts large international corporations and companies that invest in and collaborate with scientists and emerging firms.

The objective of this study is to analyse the legislative, regulatory, and institutional framework aimed at promoting the development of artificial intelligence in Bulgaria. Through an empirical analysis of existing data, the current level of development in the IT sector is assessed. Based on this analysis, the study identifies the main achievements, challenges, and issues associated with the country's technological advancement.

The leading hypothesis of the research is that the policies, initiatives, and regulatory frameworks currently being implemented should create a favourable environment for the growth of the high-technology sector. Such measures can enhance the Bulgarian economy's innovation capacity and competitiveness in the context of global technological competition.

The analysis and evaluation of the state and challenges of Bulgaria's technological development in the field of artificial intelligence involve addressing the following key questions:

1. Assessment of the legislative and institutional framework supporting the development of artificial intelligence in Bulgaria.
2. The current state of the information technology sector in Bulgaria.
3. Scientific and research activity related to AI technology in Bulgaria.
4. The state of innovation and the digital environment in Bulgaria.
5. Bulgaria's role in the creation of startups in the information technology sector.
6. Evaluation of the impact of AI technology on the labour market in Bulgaria.
7. Challenges related to the development of the IT sector in the context of Bulgaria's economic environment.

For this analysis, substantial information was used, including policy documents on the implementation of European Union strategies and regulations, as well as national strategic and legal documents on AI development in Bulgaria. Statistical findings and empirical data on the evolution of the country's IT sector have also been examined.

Given the rapid pace at which this technology evolves, such an analysis will always require regular updates. Nonetheless, it can serve as a valuable foundation for future research and development efforts. The study concludes with specific proposals related to the regulation and governance of artificial intelligence.

Assessment of the Legislative and Institutional Framework for Ensuring the Development of Artificial Intelligence in Bulgaria

The regulatory policy concerning the development of artificial intelligence (AI) technologies is currently a priority for both individual states, supranational entities, and international organisations. Bulgaria's regulatory policy on AI consists of two main components. The first concerns the existing European legal and institutional framework, while the second concerns the adoption and implementation of national-level conceptual and legislative acts governing AI development. In shaping Bulgaria's regulatory policy, the country also adopts good practices, initiatives, and measures from abroad and fulfils obligations of a supranational nature.

The European Union's regulatory framework on artificial intelligence is extensive and complex. It includes the Artificial Intelligence Act (AI Act) (EU, 2024), the General Data Protection Regulation (GDPR), the Digital Services Act (DSA), the Digital Markets Act (DMA), the Cyber Resilience Act (CRA), and the Platform Work Directive. Together, these instruments establish a comprehensive environment designed to support the development of Europe's innovation ecosystem and the AI-related sector. The overarching goal of this framework is to propose a model for the multilateral and ethical regulation of artificial intelligence. However, this approach simultaneously demands significant human, administrative, and legal resources, creating challenges – especially for startups and small and medium-sized enterprises (SMEs).

The Artificial Intelligence Act (AI Act) establishes a unified regulatory and legal framework for AI within the European Union. The main objectives of the Act are to enhance the functioning of the EU internal market by fostering human-centred and trustworthy AI while ensuring a high level of protection for health, safety, and fundamental rights. To achieve these objectives, the Act provides for:

- Harmonised rules for the placing on the market, operation, and use of AI systems within the EU;
- Prohibitions on certain AI practices;
- Specific requirements for high-risk AI systems and obligations for their operators;
- Harmonised transparency rules for specific AI systems;
- Common rules for placing general-purpose AI models on the market;

- Provisions for market monitoring, supervision, governance, and compliance enforcement;

- Measures to support innovation, with special attention to SMEs and startups.

The implementation of the AI Act entails the adoption of a considerable body of secondary legislation, including delegated and implementing acts, through which the European Commission will further refine or update certain technical aspects. From now on, the focus should not be on introducing new regulations but rather on practical implementation and the provision of adequate resources to ensure that the AI Act operates successfully in practice. Nevertheless, the volume of secondary legislation required poses a serious challenge, as the Act envisions the creation of at least 26-27 additional legal acts. While some of these will be procedural or standardised, several are expected to have a significant and direct impact on businesses and their capacity for technological growth.

Bulgaria's regulatory policy on AI is evolving within the broader European Union institutional framework. In this regard, the Concept for the Development of Artificial Intelligence in Bulgaria 2020 – 2030 was adopted. Its main goal is to focus national efforts on building scientific and expert capacity and on developing and implementing AI systems. The achievement of this goal involves the implementation of specific measures in the following areas:

- Science and research infrastructure;
- Education and skills development;
- Intelligent industry;
- Electronic public administration;
- Sustainable agriculture;
- E-healthcare.

The Concept for the Development of Artificial Intelligence in Bulgaria is grounded in the principles for the development and deployment of AI technologies adopted at the EU level. It reflects the need for a broad, inclusive approach that encourages the adoption of next-generation digital technologies across Bulgaria's economy and public sector.

Regarding the Regulation of Artificial Intelligence, it should be noted that the EU Artificial Intelligence Act establishes a two-tier governance system comprising EU-level and national authorities. National authorities will be responsible for supervising and enforcing rules related to specific AI systems, while the EU level will oversee the governance of general-purpose AI models.

At present, future national competent authorities – including those in Bulgaria – face numerous new tasks, some of which must be addressed within very short deadlines. The most important of these include:

- Establishing a national AI governance system in every EU Member State, to be implemented between 2 November 2024 and 2 August 2026;

- Adopting new national laws and secondary legislation on AI governance, with ongoing application;
- Beginning the practical implementation of national-level measures, some of which are to start as early as 2 February 2025;
- Conducting subsequent evaluations of the EU AI Act between 2025 and at least 2031.

In accordance with the requirements of the EU Artificial Intelligence Act, in 2025, a draft “Law on the Use and Development of Artificial Intelligence in Bulgaria” (National Assembly of Bulgaria, 2025) was submitted to the Bulgarian Parliament. According to this proposed law, the state policy on the use and development of artificial intelligence is to be carried out by:

- The Minister of Electronic Governance, concerning the use and development of AI in the public sector;
- The Minister of Innovation and Growth, about the development and use of AI outside the public sector.

The Prime Minister, upon the proposal of the Minister of Electronic Governance, is granted the authority to appoint a National Coordinator for the Use and Development of Artificial Intelligence (hereinafter referred to as the National Coordinator).

The National Coordinator, when exercising his or her functions in implementing the state policy on AI, has the following powers:

- To lead the preparation and updating of the National AI Strategy and its accompanying Roadmap;
- To review and approve program proposals under the law;
- To review and approve reports prepared under the law;
- To ensure coordination among the competent sectoral authorities;
- To summarise and analyse the activities of market surveillance bodies;
- To participate in consultative councils in the fields of e-governance and innovation;
- To perform other functions as defined by law.

The Council of Ministers, upon the proposal of the Minister of Electronic Governance and in coordination with the Minister of Innovation and Growth, the Communications Regulation Commission, and the Commission for Personal Data Protection, adopts a Regulation for the Implementation of this law.

The law governs all matters delegated to the Member States under the EU AI Act, including the designation of national competent authorities, the procedures for imposing sanctions, the storage of documentation under the regulation, and the maintenance of relevant registers.

According to the law, the following are designated as national competent market surveillance authorities:

- The Financial Supervision Commission – for the use of AI in insurance, investment, and pension activities;
- The Bulgarian National Bank – for the use of AI in credit institutions;
- The Executive Agency “Medical Supervision” – for the use of AI in health-care and medical institutions;
- The Council for Electronic Media – for media services using AI;
- The Executive Agency “Automobile Administration” for transport services using AI;
- The Commission for Personal Data Protection for designated high-risk AI systems;
- The Communications Regulation Commission for all other sectors.

The Minister of Electronic Governance serves as the notifying authority under the EU Artificial Intelligence Act.

The Minister of Electronic Governance, together with the Communications Regulation Commission, appoints Bulgaria’s representatives to the European Artificial Intelligence Board.

According to the law, the national bodies for the protection of fundamental rights in Bulgaria, within the meaning of the EU Artificial Act, are as follows:

- The Commission for Protection against Discrimination;
- The Commission for Personal Data Protection;
- The Ombudsman of the Republic of Bulgaria;
- The Executive Agency “General Labour Inspectorate”;
- The State Agency for Child Protection;
- The Commission for Consumer Protection;
- The Executive Agency “Medical Supervision”;
- The National Bureau for Control of Special Intelligence Means;
- The State Agency for Refugees.

When assessing the applicable legislative and institutional framework for the strategic development of artificial intelligence in the European Union and, by extension, in Bulgaria, it is important to consider the requirements outlined in the concept of the “AI Triad”, proposed in 2020 by Ben Buchanan (Buchanan, 2020). According to this concept, the three fundamental components of artificial intelligence are data, algorithms, and computing power. This triad should serve as the basis for formulating and implementing national policies and regulations to foster a comprehensive AI ecosystem.

Each of the three elements is essential, though their relative importance may shift as the technology evolves. Each component also offers unique tools for regulatory intervention. Specifically, regulatory policies should promote research on algorithms, as they underpin AI and strategic planning. Data serve as the means through which machine learning systems are trained. Larger and more representa-

tive datasets generally lead to more accurate and reliable outcomes. However, legal restrictions on data use may hinder the effectiveness of AI systems. Therefore, policy decisions must balance data accessibility with privacy and ethical considerations to encourage the development of efficient and impartial AI systems.

Computing power has become increasingly critical for deploying complex algorithms and processing large datasets. Progress in artificial intelligence is directly linked to access to substantial computational resources. Hence, political and regulatory measures should aim to ensure adequate computing capacity for AI research and development.

The AI Triad concept clearly demonstrates that the effective development of artificial intelligence requires a balanced and integrated policy approach. Regulatory decisions must address all three core components- algorithms, data, and computing power.

Successful policies should:

- Stimulate innovation in algorithm development;
- Ensure access to high-quality, representative data while upholding ethical and legal standards;
- Guarantee the establishment of the necessary computational infrastructure.

Decision-makers responsible for AI governance must design strategies that enable the full realisation of AI's potential for economic growth and national security.

With regard to the European and, consequently, the Bulgarian regulatory framework, it is evident that it prioritises minimising potential risks and promoting the ethical use of artificial intelligence. Structurally, this framework aligns with the core elements of the "AI Triad": data, algorithms, and computing power.

However, it should be observed with concern that the regulatory burden on European companies remains high and continues to grow. At the same time, the EU still lacks a unified methodology for assessing the overall regulatory burden. Despite the European Commission's longstanding efforts to reduce both the "stock" and "flow" of regulations, these efforts have had limited effect. The regulatory load remains substantial, and new EU regulations are being introduced at a faster rate than in other major economies.

In this context, it is important to recognise that excessive and cumbersome regulation can undermine the competitiveness of the European economy. Such overregulation may also lead to significant adverse social consequences, including job losses, widening inequalities, slower social progress, and growing public discontent.

Therefore, it is crucial that regulatory authorities, at both the European and national levels, exercise care and flexibility, seeking to strike an optimal balance between necessary oversight and the encouragement of innovation.

To address these challenges, several recent reports and policy proposals have been presented, notably by Mario Draghi (2024), former President of the European Central Bank; Enrico Letta, former Prime Minister of Italy (2013 – 2014) and current President of the Jacques Delors Institute. These analyses emphasise the need for more efficient, innovation-oriented regulation capable of maintaining Europe’s competitiveness in the global technological race.

The State of the Information Technology Sector in Bulgaria

Data presented in the annual report of the Bulgarian Association of Software Companies (BASCOS) indicate that artificial intelligence technologies have been adopted by an unprecedented 100% of software companies in Bulgaria (Mediapool, 2024b).

The Bulgarian software industry’s revenue growth in 2023 exceeded 1.23 billion BGN, representing a 16.5% annual increase, with total revenue reaching 8.7 billion BGN. During the same period, 451 new software companies were established, and 2,675 new jobs were created. The software industry continues to maintain its leading role in research and development (R&D) investments and its top position in Bulgaria’s export of services. Its contribution to the state budget also remains significant: software companies pay more than three times the national average in taxes and social security contributions, according to the report’s findings.

Expectations for 2024 are also positive, projecting 12.4% growth, which is notable given forecasts of weak growth and uncertain prospects for the Eurozone economy.

It should also be noted that investors from 34 countries are present in Bulgaria’s software sector, with major research and development centers owned by companies from the United States, the United Kingdom, Germany, France, and the Netherlands.

Nearly one-third (28%) of Bulgaria’s total export of services comes from software products and services, which account for 85% of the sector’s total revenue.

The total number of employees in the software industry is approximately 60,000 people, representing 1.9% of all employed persons in Bulgaria. Each worker in the software industry generates over three times more budget revenue in taxes and fees than the national average. The total tax revenue from the sector in 2024 is expected to exceed 2.7 billion BGN.

At the regional level, Bulgaria remains a leading destination for IT and business process outsourcing (BPO) in Southeastern Europe. Together with Romania, the two countries generated over 13 billion euros in revenue in 2023 (Mediapool, 2024a). The total revenue from IT and BPO in Southeastern Europe reached 17.1 billion euros in the same year.

Bulgaria ranks 25th globally as one of the most competitive locations for outsourcing services, while maintaining its leading position in Southeastern Europe. However, Bulgaria remains among countries with a moderate focus on developing digital skills and innovation, which limits its potential for long-term growth.

Bulgaria stands out for its strong linguistic capabilities, ranking third in Southeastern Europe and 16th globally in English proficiency, according to the English Proficiency Index 2023. German is the second most widely studied foreign language in Bulgarian high schools, followed by French and Russian. This linguistic advantage reinforces Bulgaria's position as an attractive destination for international technology companies.

Scientific and R&D Activities Regarding Artificial Intelligence Technology in Bulgaria

The Institute of Computer Science, Artificial Intelligence and Technology (INSAIT) is a leading national institution for conducting scientific and R&D activities in artificial intelligence in Bulgaria. It is located in Sofia, Bulgaria, and is the first of its kind in Eastern Europe to offer world-class research facilities and conditions. INSAIT was founded in April 2022 in partnership with Switzerland's ETH Zurich and EPFL, two of the world's top technical universities, and is advised and overseen by leading academics from some of the most elite American, European, and Israeli universities and research laboratories. Donations from Google, Amazon Web Services, DeepMind, SiteGround, VMware, and numerous technology entrepreneurs support INSAIT's activities. The sole focus of INSAIT is on scientific achievements: conducting world-class research, attracting exceptional international scientists, and educating the next generation of students and technology leaders.

In 2024, INSAIT introduced a next-generation artificial intelligence model designed to operate in Bulgarian. In this way, Bulgaria became the first European Union member state to have artificial intelligence at such a high technological level in its native language.

The institute's new generative model is freely accessible and can be integrated into the systems of any Bulgarian institution, private company, or public organisation. A key advantage of the model over paid platforms is its provision of information security; it can be used by an organisation without the need to share its data with external companies.

INSAIT's models are based on Google's open-source Gemma-2 models, but their performance in Bulgarian became possible as a result of systematic scientific research conducted at INSAIT. This led to the development of a new technology that enables a generative model to be trained with additional knowledge

(e.g., Bulgarian) without forgetting prior skills (e.g., English). This technological breakthrough was published at EMNLP'24, a leading artificial intelligence conference held in Miami, USA.

Another significant institution that plays an important role in scientific and R&D activities related to artificial intelligence in Bulgaria is the “Big Data for an Intelligent Society” Institute (GATE). It is a centre of excellence in Bulgaria, working to integrate and expand scientific achievements and innovations in priority areas such as big data and artificial intelligence at the regional and European levels. The institute aims to attract and develop the next generation of researchers under the guidance of leading scientists in the fields of big data and artificial intelligence.

The “Big Data for an Intelligent Society” Institute (GATE) was established in 2019 as an autonomous structure within Sofia University “St. Kliment Ohridski”.

GATE conducts applied research, develops innovations, and creates educational programs in the fields of big data and artificial intelligence in collaboration with the government, industry, and entrepreneurs.

GATE develops research capacity and potential in big data and artificial intelligence, forming the next generation of leading scientists through the expansion of the existing research network and the establishment of long-term agreements with leading global organisations.

In July 2024, it was decided that the Bulgarian supercomputer “Discoverer” would be upgraded by adding several components to the current systems to improve performance and ensure long-term data storage for tasks requiring intensive computations and a large number of input-output operations. Increasing the performance of the Bulgarian supercomputer will help turn it into a “strategic asset for the development of science”, stated Sofia Tech Park at the time.

Current research indicates that Bulgaria ranks eighth in Eastern Europe in terms of the number of scientific publications in artificial intelligence, with a total of 3,045 documents (SCImago Journal & Country Rank, 2023). This quantity places the country in the mid-range by volume, indicating the presence of active research activity. Nevertheless, qualitative indicators remain lower compared to leading countries. The average number of citations per document is only 4.20 – significantly below Slovenia’s level and even below the regional average. The H-index is 42, indicating a moderate influence of Bulgarian research in the international context. These values suggest limited impact and visibility in the global academic ecosystem. While Bulgaria demonstrates a stable quantitative presence, SCImago data clearly show the need to improve the quality, impact, and international recognition of Bulgarian scientific research in artificial intelligence.

In March 2025, the European Commission identified Bulgaria as one of the countries where six new European artificial intelligence (AI) factories will be

established. The EuroHPC Joint Undertaking for European High-Performance Computing selected a total of six new European AI factories to strengthen Europe's position in innovation and artificial intelligence. With the designation of these new factories, their total number rises to thirteen.

In addition to Bulgaria, AI factories are planned to be built in Austria, France, Germany, Poland, and Slovenia. They will be supported by a combined national and European investment of €485 million. Bulgaria won a project worth €90 million in competition with some of the most developed European countries. The success of the Bulgarian application is largely the result of the joint work between Sofia Tech Park and the Institute of Computer Science and Artificial Intelligence (INSAIT).

The Bulgarian artificial intelligence factory, named BRAIN++, will be located at Sofia Tech Park. It will include two main components. The first is called Discoverer++ and represents a next-generation supercomputer capable of handling cutting-edge workloads. The second component is the AI factory itself, which will serve as a one-stop centre for government, educational, and private organisations.

According to the European Commission, the task of BRAIN++ will be to position the country as a regional leader in innovation. It will integrate its activities with other AI factories in Europe. The construction of BRAIN++ will begin in 2026. INSAIT's team will assist in developing generative models for earth observation, robotics, large language models, and more. The project may build upon INSAIT's existing work in positioning the country as a regional leader in AI and innovation. The goal is to encourage workforce development and support startups, small and medium enterprises, as well as researchers. This could give a boost to important sectors such as robotics, space research, healthcare, pharmaceuticals, disaster management, and more.

State of Innovation Activity and Digital Environment in Bulgaria

Innovation activity and the digital environment in Bulgaria show steady rates of development. According to data from the National Statistical Institute (NSI, 2024), during the period 2020 – 2022, 26.1% of enterprises with more than nine employees engaged in innovation activities. The innovation activity of enterprises in the industrial sector (32.9%) is higher than that of enterprises in the services sector (19.6%). The highest share of innovation-active enterprises is in the group of large enterprises (with 250 or more employees) – 72.3% in industry and 66.5% in services.

However, according to available information, Bulgaria significantly lags behind in the overall process and implementation of the strategy. According to Eurostat data (Eurostat, 2024) from May 2024, the country ranks second to last in

the use of artificial intelligence technologies. Moreover, it turns out that Bulgaria lags behind in the development of artificial intelligence (AI) projects, allocating only 0.62% of digitalisation funds for AI projects from the EU's Next Generation EU (NGEU) instrument and its Recovery and Resilience Facility (RRF), which has a total value of €117 billion. Only €10.18 million was allocated for activities carried out in Bulgaria (Forbes, 2024).

In 2022, the turnover of innovation-active enterprises accounted for 51.9% of total turnover, and the number of employees 51.8% of all employees in all enterprises. During the observed period, 15.0% of all enterprises implemented product innovations (new or improved goods and services), while 17.8% introduced new or improved business processes.

The risks posed by artificial intelligence are already visible, including for employment. A study by "LS-S Leadership Support" (ISS/4/068/2024) conducted at the end of 2023 among more than 200 companies operating in 10 sectors in Bulgaria and Germany shows that 54% of Bulgarian firms use AI occasionally or more frequently, while about one-third have tried such applications or have at least a general understanding of them. Nearly 60% expect AI to have a substantial impact on their work processes or to fundamentally change them, while only 10% expect little or no effect.

The use of artificial intelligence in Bulgaria is highest in the fields of information technology, marketing and communications, research and development, and human resources. In each of these fields, over 50% of organisations either already use AI, test it, or have concrete plans for its implementation. Compared to Germany, Bulgaria has a higher percentage of companies using AI frequently (25% versus 13%).

An interesting fact is that 45% of companies in Germany have implemented rules for AI usage, while in Bulgaria, it remains largely unregulated. With the growing popularity of chatbots, the capabilities and potential of AI are becoming increasingly clear to the public. This issue should be addressed in Bulgaria through the introduction of the EU Artificial Intelligence Regulation of 2024.

A study by Telerik Academy (Telerik Academy, 2023) conducted at the end of 2023 among 150 professionals with different experience levels and positions regarding AI use in the workplace shows that:

- Nearly three-quarters (73%) of employees in Bulgaria use AI tools at work at least once a week;
- Over half (52%) of respondents emphasise the importance of understanding how to effectively integrate large language models (LLMs) into their daily tasks;
- 96% of respondents indicate that AI-generated solutions need to be adapted before implementation;
- Over 50% express a lack of confidence in effectively using large language models.

Survey research by some social partners also provides detailed data on AI use in specific groups of enterprises. For example: surveys by the Bulgarian Industrial Association (BIA) on data and AI, research by the Confederation of Independent Trade Unions in Bulgaria (CITUB) on platform work.

Bulgaria's Position in the Creation of Startups in the Information Technology Sector

Bulgaria's leading position in the information technology sector in Southeastern Europe is supported by its role as a leader in the process of creating startups.

According to research in the Startup Ecosystem Index 2024 (Startup Ecosystem Index 2024), Bulgaria climbed one position to rank 37th in the world while maintaining 23rd position in Europe. This index ranks the best cities and countries globally for startup development.

Bulgaria continues to lead the Balkans, increasing the gap compared to its closest regional competitor, Romania. The country has three cities in the global top 1000, with an additional city, Plovdiv, included in the Index, all of which have improved their positions compared to the previous year. Sofia, the top city in Bulgaria, has an overall score 20 times higher than Varna, which is ranked second, highlighting the centralisation of the startup ecosystem in the capital. Sofia improved by two positions to rank 117th globally, representing a climb of six positions over two years, making the capital the runner-up in the Balkans, surpassing Athens.

The best-performing industry in Sofia is Social & Leisure, which ranks in the top 10 in Eastern Europe and the top 100 globally. Despite having a relatively small market, Bulgaria provides conditions for a stable startup ecosystem: strong digital infrastructure, a variety of support programs, a favourable tax environment, and access to top technological talent at a relatively low cost. Bulgaria has established a strong support environment for startups with numerous successful accelerators and incubators. A key achievement of the local startup ecosystem is the first Bulgarian unicorn, Payhawk. This success story has revitalised local ecosystems, as Bulgaria attracts attention from American and Western European venture capitalists, according to the analysis.

Bulgarian startup ecosystems are popular destinations for European entrepreneurs and digital nomads, drawn by low living costs and effective conditions offered by the public sector.

Supporting this framework is the work of BESCO, which helps the public sector create and implement policies related to startups and a macroeconomic environment conducive to growth. Similarly, private organisations such as Vitosha Venture Capital (Vitosha VC) and Endeavour Bulgaria have made significant contributions.

Taking advantage of this support, Bulgarian startup ecosystems have begun to secure broader financial backing, particularly through EU funding, which has given a boost to startups. An example of EU involvement in Bulgarian startup ecosystems is the Fund of Funds, a key component in rapidly scaling the ecosystem.

Regarding the evaluation of the business startup process in Bulgaria, the latest Eurobarometer survey shows that Bulgaria ranks first in Europe in the willingness of young people to start their own business. This is explained by a strong entrepreneurial culture and collaboration between the information ecosystem and the academic sector. Data indicates a growing number of startups in Bulgaria in both the technology and biotechnology sectors. To support these processes, partnerships between businesses and universities need to be expanded (Stoycheva, 2024).

These findings suggest that in recent years, Bulgaria has established itself as a key destination for companies seeking to invest in innovation, leading to increased investment and the creation of funds that invest in startups and finance these processes. These startups have subsequently integrated with large global companies, positioning themselves in the global market, thereby establishing Bulgaria as one of the most successful countries in the region. A whole ecosystem has been created that enables the development of a high-tech industry.

Assessment of the Impact of Artificial Intelligence Technology on the Labour Market in Bulgaria

According to the results of another study (Kaderabotim, 2024) conducted in 14 European countries, 69.20% of Bulgarian companies support the use of artificial intelligence (AI) in the workplace. By this measure, Bulgaria surpasses Hungary, Romania, Greece, and Moldova.

The main reasons for this positive attitude toward AI among Bulgarian employers are the expectations that the technology will reduce employee workload and save time (45.87%) and that it will help automate specific tasks, reducing the need for external personnel (37.03%). However, 3.06% of the participants indicated that they expect AI tools to reduce the hiring of new employees.

It should be noted, however, that only 19.71% of Bulgarian participants reported using specific AI tools for human resource management. Nearly half of the respondents (48.36%) answered negatively to this question, while the remaining 31.94% indicated that they do not use such tools “yet.” Among those who responded positively, the most preferred AI model is ChatGPT, used by 83.24% of users.

According to a survey conducted by Trend Agency in 2023 on Bulgarian attitudes toward AI, 45% of respondents believe that AI will lead to job losses, while

only 4% see potential for creating new jobs. Among the respondents, 37% worry that AI could replace human labour in their field. Nearly one-fifth expressed the opinion that AI should be banned because it poses a danger to humans.

These data indicate that the labour market in Bulgaria will depend on the ability of workers and employees to adapt to changes associated with new technologies and the green transition, which will require additional investments in training.

A study by Fujitsu and Pierre Audoin Consultants on the adoption and benefits of AI (Irish Tech News, 2018), conducted among 240 European companies, shows that 80% of businesses expect significant benefits from process automation and the elimination of the human factor. Seventy-three per cent believe this will lead to faster implementation of business processes, and 72% expect more and better recommendations from AI for forecasting activities, such as predictive insights and ideas for new products and services.

Comparing Bulgaria with other EU member states regarding the impact of AI on the labour market, it can be said that the country has a relatively new but well-structured and rapidly developing AI sector. Bulgaria has strong traditions in computer science and information technology, and several Bulgarian universities offer programs related to artificial intelligence.

Challenges Related to the Development of the Information Technology Sector in Bulgaria Concerning the Economic Environment

Bulgaria significantly lags behind in attracting foreign investments. To compensate for this gap, the Bulgarian government needs to determine which sectors of the economy should be prioritised as leading in the new century. If high technologies are not made a priority, the country risks falling critically behind in its economic development.

Unfortunately, Bulgaria was one of the last EU countries to introduce a screening mechanism for foreign investments from third countries. This approach requires each country to identify key sectors crucial for national security and monitor which foreign investors enter them. While this identifies strategic sectors, it also reduces the inflow of capital due to restrictions. To compensate for this loss, many countries have implemented targeted measures to develop these sectors, including substantial investments in infrastructure, education, and initiatives to attract high-tech investors. In Bulgaria, however, such measures are absent and not applied.

According to the Bulgarian Entrepreneurship Association (BESCO), a leading non-governmental organisation, the current legislation is inadequate for modern

conditions, where even industrial and strong economies, such as Germany and the United States, provide substantial subsidies to attract strategic investors.

An analysis by the World Bank notes that, although Bulgaria is now a middle-income country, the traditional growth factors (such as integrating the unemployed into the labour market and domestic investment) are becoming exhausted. A new growth model is therefore required. According to World Bank experts, the country could achieve 100% convergence with the European Union within 15 years if the economy grows by more than 4% annually in the coming years. To reach this result, the country must attract private investments amounting to at least 25% of its GDP.

In addition to these evidently non-competitive conditions, traditional problems persist: cumbersome administration, outdated or missing regulations, shortages of qualified labour, an education system that does not develop necessary skills, doubts about the rule of law, and political instability in recent years.

A significant issue in Bulgaria's economic environment is the taxation system. Representatives of the IT sector argue that the claim of low tax burden in Bulgaria does not reflect reality. They claim that effective taxes paid by tech companies in other markets may be lower than those paid in Bulgaria. Although other countries apply higher nominal rates of 20–30%, they often allow numerous exemptions and deductions. In contrast, the effective tax burden for technology companies in Bulgaria can reach 40% (including social and health insurance contributions), making the country non-competitive as an investment destination.

Another serious challenge is the pace of high-tech adoption in practice. Bulgaria needs to rapidly close the gap in implementing modern technologies, as only 29.3% of enterprises in the country adopt advanced technologies (cloud computing, data analytics, or AI), well below the EU average of 54.6%. Due to this, Bulgaria ranks last among EU member states in this respect.

The education system in Bulgaria poses another major challenge for the high-tech sector. Insufficient investments in education, only 3.9% of GDP, deepen regional disparities and limit economic prospects. To address this issue, it is necessary to:

- Overcome the shortage of basic to advanced digital skills;
- Enhance digital inclusion for vulnerable population groups;
- Foster digital skills from early childhood throughout working life.

However, education remains a significant challenge, as only 5.5% of students specialise in STEM disciplines, and 54% are functionally illiterate in mathematics according to international PISA assessments.

Recommendations for the Development of Artificial Intelligence Technology in Bulgaria

A clear understanding of the existing challenges and opportunities related to the development and application of artificial intelligence (AI) is provided by the Government AI Readiness Index 2024 report by Oxford Insights (Oxford Insights, 2024), which highlights key global and regional trends. In 2024, there has been a significant increase in activity regarding national strategies and policies related to AI.

The assessments in this index show that the United States continues to dominate, due to the maturity of its technology sector, strong innovation culture, and balanced regulatory framework. Meanwhile, the European Union, with an average score of around 70 points, demonstrates stability and high effectiveness in ethical standards, governance, and legal regulation. The study concludes that the EU has strong institutional capacity and regulatory frameworks but remains behind the U.S. in terms of innovation and technological capability. A targeted policy is needed to support startup ecosystems and public-private partnerships in the AI sector.

The Eastern European region records an average score of 57.88 points, positioning it above the global average. The best-performing country is Estonia – 72.62 points, which is the only country in the region among the global top 25, followed by the Czech Republic – 70.23 points, Poland – 67.51 points, and Lithuania – 67.80 points. The technology sector remains a weak link in the region, with a score of 39.03 points, placing it among the lowest globally. This clearly indicates the need for investment in innovation, incentives for startups, and the development of human capital in STEM fields.

It is important to note that more and more countries in the region are formulating or updating their national AI strategies. Examples include Moldova, Romania, and Poland, which focus both on economic competitiveness and the ethical use of AI.

With a score of 60.64 points, Bulgaria is positioned above the regional average of 57.88 and above the global average of 47.59. Regarding the three pillars evaluated in the index, Bulgaria performs strongly in: “Government” – 65.19 points, “Data and Infrastructure” – 78.85 points. However, the country performs very poorly in the “Technology Sector” indicator, which is rated at 37.88 points.

These data clearly show that, although Bulgaria has some institutional and infrastructure achievements, it requires a profound and timely technological transformation to overcome its significant lag. Implementing a national AI strategy with measurable goals, developing an entrepreneurial ecosystem, and investing in human capital are imperative for positioning the country among digitally advanced nations.

Achieving the goals for the development of artificial intelligence in Bulgaria requires addressing the existing challenges and problems in an adequate manner.

These relate to building the institutional and legal framework for AI, optimising foreign investment policies, reforming the education system, improving the economic environment, and ensuring modern communication and scientific infrastructure for the development of digital technologies. To achieve these objectives, the following measures are recommended:

1. Support and accelerate foreign investment in the IT sector.

State support should be expanded and targeted primarily at production investments, especially in sectors with medium and high added value. Additionally, the thresholds for granting state aid should be simplified to facilitate the process.

2. Qualitative improvement of the tax system in Bulgaria.

A well-structured corporate tax system should follow the principles of stable fiscal policy, be easy to administer, and be predictable for businesses. Clear and foreseeable fiscal incentives should be defined, and their implementation should enable revenue collection with minimal economic distortions.

3. Enhancement of intellectual property protection.

Strong IP protection is critical for attracting IT investments. Many companies prefer to register in jurisdictions with stronger protection while operating in Bulgaria due to the lack of a fair and independent judicial system. Leading innovative companies such as Payhawk and Dronamics are examples of firms not registered in Bulgaria, which limits the country's capacity to retain high-value tech investments.

4. Removal of Bulgaria from the FATF “grey list” for money laundering.

Being on the grey list negatively affects IT and fintech development. Measures should be implemented to resolve this issue by the end of 2026, particularly for fintech companies that rely heavily on anti-money laundering regulations.

5. Establishment and operationalisation of an AI regulatory sandbox by 2026.

The sandbox should serve to test AI models before their deployment in public institutions. It should also facilitate the training of public administration employees working with AI systems.

6. Strategic transformation of the Bulgarian capital market.

Currently, businesses rely mostly on reinvested profits and bank loans, leaving the stock market passive. To revitalise it, measures should encourage potential investors through transparent incentives, increased liquidity, access to external capital, and growth opportunities via the stock market. A clear and consistent market approach would restore the stock exchange's role as a source of capital for scaling successful entrepreneurial ventures.

Implementing these recommendations can create a favourable environment for high-tech investments. Additionally, there should be a policy of selective support for strategically important sectors, actively promoting higher technological levels within the country.

Conclusion

The rapid advancement of artificial intelligence is radically changing the majority of sectors of the economy and society. Although the ideas and some fundamental tools of artificial intelligence emerged long ago, today, as a result of accumulated computational capacity, communication potential, and big data, the world is facing fundamental transformations that are much more comprehensive than the technological revolution of the last century. The leading trends at the present moment in the digital industry are systems based on artificial intelligence and automation for robots, cloud-based solutions, big data processing, and others. Therefore, the investments that require targeted support should be those that support the implementation of technologies related to the leading trends in the digital economy.

The results of the present analysis show that what has been achieved so far, despite the existing problems, provides grounds to conclude that Bulgaria has the necessary potential to establish itself as an attractive investment destination.

Solving the existing problems requires interaction and coordination in activities carried out by state institutions, business structures, scientific and academic organisations, and the non-governmental sector. Of exceptional importance will be both the allocation of public financial resources and the mobilisation of private investments for the development and wide use of artificial intelligence technology.

The solving of the mentioned problems should be addressed systematically and unwaveringly through the efforts of the entire society. In this way, Bulgaria can develop its necessary scientific, expert, business, and managerial capacity and maintain its leading position in the development of artificial intelligence technology in the context of global technological advancement.

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