

# ANNUAL AI REPORT

2022

| BULGARIA



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# Humans Working With Artificial Intelligence (AI)

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# Statement from the Board of AI Cluster Bulgaria

Bulgaria has clearly stated its ambition for economic growth based on innovation and science, promising help to synchronise all key local projects in this area and identify instruments for their financing. But the road is long and experienced advisory is required. Investment, nurturing the best ideas, spinning out and venture building from academia and centres of excellence, faster ecosystem development, and economic resilience are our priorities and key activities. The potential of AI can be found across every economic sector, entertainment, finance, health, retail, manufacturing and more.

In the near future, adopting AI technologies will be a key driver of change and innovation in Bulgaria. Improvements to business and public sector services facilitated by AI will benefit the nation. There are considerable societal implications of AI, including ethical concerns, detecting bias, accountability, and the changing workforce. All of which Bulgaria must address. This report gives us all a map, a baseline of understanding, and ideas essential to informing what we can do now in the coming months and years.

AI Cluster Bulgaria aims to foster an environment where AI delivers benefits to the entire country. To achieve this goal, we are bringing general AI awareness on the technology, including what it can help achieve in business and society, as well as the risks of failing to adopt it. We need to actively engage with AI now to secure our future prosperity.

As a trusted independent body, AI Cluster Bulgaria will continue to facilitate the development of a cohesive national strategy, a moderated conversation between the public and business stakeholders, work on Bulgaria's strong international presence, support the commercialisation and internationalisation of Bulgarian companies and scientists, and collaborate with the local ecosystem to build the next-generation capability for Bulgaria's AI future.

## AI Cluster Bulgaria



### **Kristina Eskenazi**

Member of the Managing Board of the AI Cluster Bulgaria  
Chair of Health & Life Sciences Cluster Bulgaria

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The AI Cluster Bulgaria is a Non-Profit Organization that is bringing the knowledge for ML, NLP, IoT, AR, VR, Computer Vision & Pattern Recognition, Big Data & Analytics, 3D Printing, Cloud Computing and Networking & Interconnectivity - Smart Cities.

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## Preparing for the AI-driven future in the consumer industry

The advancement of Artificial intelligence (AI) has created opportunities to disrupt traditional ways of operating, coordinating and optimizing activities across organizations.

### What do we really mean by AI?

AI is a suite of technologies and methodologies that use advanced algorithms to 'learn' from large amounts of data, imitating three behaviours that are traditionally associated only with human intelligence: interacting with other humans, completing routine tasks, and generating insights and predictions about future events.

### Building a more robust, data-enabled AI business model is now imperative

The unprecedented availability of data, along with cloud and AI capabilities to process and learn from it, is creating many opportunities for consumer companies to reimagine agility in their business processes. The adoption of these new data- and AI-enabled processes will separate the winners from the losers, equipping them with the ability to better sense and respond to changes in consumer behaviour, optimize performance and customer relevancy in turbulent times, and handle supply/demand shocks or other unforeseen business disruptions with greater resiliency.

To become an AI-first organization, first you must define what role AI will play in your business and the value you expect it to generate. This will give your organization a vision of the capabilities, skillsets, and applications to rally around and guide the journey as you navigate through some of the common use cases below:

### Understanding, predicting, and shaping customer demand

**AI can enable an accurate and timely understanding of your customers' needs and direct them to products. At the same time, respond to micro and macro changes in consumer demands trends.**

Reducing the likelihood of an unexpected shock to inventories. Understanding the complete customer journey with a greater transparency into how the customer interacts with your enterprise across different channels. Segmenting your customer base to differentiate and customize your offerings based on their specific needs.

By combining data from multiple channels with the power of machine learning, consumer businesses can better understand the complex relationship between customers and products across all touchpoints. Mining internal and external data to gain insights into the preferences of similar individuals, allows organizations to create offers, incentives, and a shopping experience that appeal to a specific set of people.

### Improving operational efficiency

**Machine learning and AI can help improve operational efficiency incrementally.**

Using new sources of data, new techniques, and automation, consumer businesses could radically improve their operational productivity at the hyper-localized level.

Adopting data science and machine learning techniques will allow companies to automatically determine and optimize performance, increase productivity, and minimize constraints. AI can also help remove steps from manual



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processes, freeing people to perform more strategic tasks and develop further system improvements.

**Building supply chain resiliency**  
**Companies can improve the resiliency of their supply chain by harnessing data that can be used to predict the risks and provide mitigating strategies to protect against uncontrollable external factors.**

As supply chains stretch farther around the world, they get even more difficult to manage because of things like unpredictable weather patterns and external sources of risks.

The data available through social media streams could provide valuable live information about the status of locations, assets, sentiments, and weather in various regions; it could be used to make better decisions. Data availability and appropriate insights are critical for any system to manage supply chain risks effectively. With simulation and digital twin technology, companies can facilitate a faster analysis process, a faster quantification process, and often better suggestions for mitigation based on a wide-ranging analysis of past scenarios.

**AI Empowering TaxTech**  
**AI and ML can be employed to dramatically improve the capabilities of traditional RPA tools through "intelligent automation" of compliance within the tax department of the organization.**

Through an iterative learning process, AI enabled applications are fed large amounts of data, which they automatically process for the desired function - either validation or correction. As more transactional services are digitized, more data is created, which may also be fed back into the AI and ML models, thus constantly improving tax processes with increasing accuracy and consistency.

As more accounting and finance tools become digital, AI can play a larger role within an organization seeking to leverage intelligent automation to manage the analysis of dense and complex tax regulations and applicable laws, receipts and invoices, as well as other written text. While scanning physical bills to capture the relevant information would be an arduous and slow method of documentation, by combining Optical Character Recognition (OCR) and AI algorithms, digitized invoices and bills can be run as scripts in the development processes, making AI a far more realistic and capable solution for downstream tax compliance work.

**The scale of becoming an AI-enabled organization can seem daunting, but a focused, value-based, and incremental approach to adoption will help to deliver immediate value and mobilize the entire organization to move toward a new future.**

# Bulgaria and AI: key facts

Bulgaria ranks 26th of the 27 EU Member States in the European Commission Digital Economy and Society Index (DESI) in 2022. Bulgaria's DESI score grew at an annual average of 9% over the past five years. Given the positioning of the country, this growth rate is not sufficient for it to catch up with the other EU Member States. On digital skills, despite recent increased efforts, Bulgaria remains significantly below the EU average, having a score of 32.6 versus the EU average of 45.7. The proportion of individuals with at least basic skills and above basic digital skills is well below the EU average, the latter significantly so (8% versus the EU average of 26%). Considering the EU's ambitious target of 80% of adults having at least basic digital skills by 2030, the country needs to step up efforts, as more than two thirds of its population lacks such skills. Bulgaria also underperforms on the proportion of ICT specialists in the workforce (3.5% versus 4.5% EU average). However, the proportion of female ICT specialists is high.

On the business side, the adoption of digital technologies by SMEs remains almost half the EU average. Only 6% of Bulgarian enterprises use big data, 10% cloud and 3% artificial intelligence (AI), as opposed to the EU 2030 targets of 75% for each technology. To support business digitalisation, Bulgaria is making use of European Digital Innovation Hubs. Four European Digital Innovation Hubs proposed by the country received a successful evaluation result and another eight proposals got a Seal of Excellence.

In the area of public wi-fi networks, Bulgaria is among the frontrunners in WiFi4EU, with 97% (257 of 265) of the country's municipalities having taken part in the four calls for applications held between 2018 and 2020. The 242 successful municipalities were awarded EUR 3.63 mln.

In the last quarter of 2021, Bulgaria presented a draft proposal for the implementation of the 'Cybersecurity Bulgaria 2030' National Security Strategy. In 2021, the National Computer Security Incident Response Team updated its roadmap for amending the national Cybersecurity Regulation in accordance with EU directives in order to secure the funding of the projects included in the strategy.

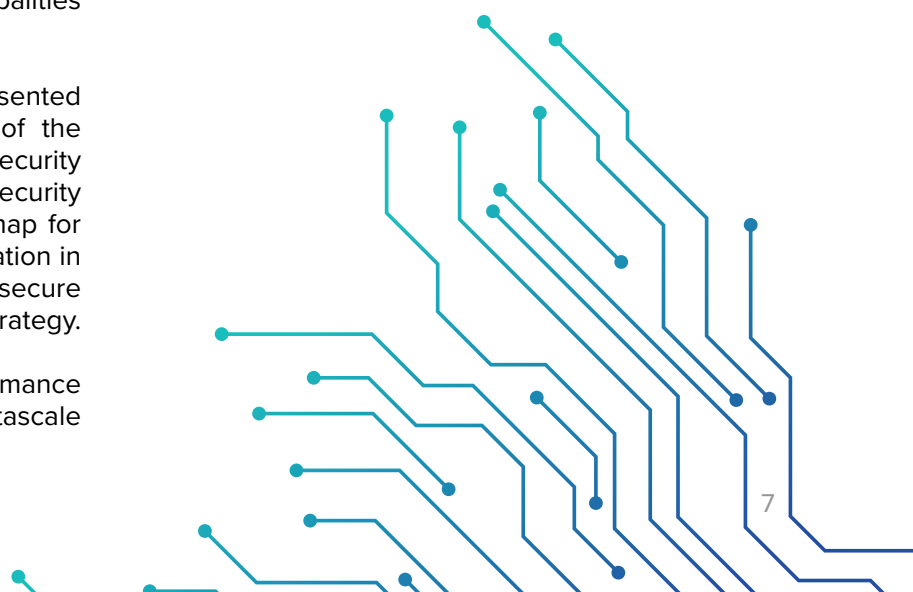
Bulgaria plays a prominent role in high-performance computing in Europe with its petascale supercomputer.

## Petascale supercomputer

Bulgaria, as a founding member of the European High Performance Computing Joint Undertaking (EuroHPC JU), has supported the establishment of a petascale supercomputer located in Sofia Tech Park. The supercomputer cost EUR 11.5 mln and was inaugurated in October 2021. It will be subsidised by EU and national funding. The supercomputer, together with other high-performance systems and the Distributed Computing Grid Clusters, is openly accessible to the research community and other private and public users. Bulgaria is also a member of the EuroQCI initiative to upgrade its national cybersecurity infrastructure with quantum-level cryptographic keys. A project called QUASAR for the establishment of a competence centre in quantum communication and intelligent security is ongoing.

Taking into account the complex picture of progress, the report "Science, Research and Innovation Performance of the EU 2020: A Fair, Green and Digital Europe", published in May 2020, gave a relatively good assessment of the Bulgarian government's readiness to develop AI, ranking the country ahead of five other EU Member States. The same place was assigned to the country by the report of the McKinsey Global Institute from 2019.

Bulgaria has a large number of artificial intelligence (AI) players across industry, research and startups relative to the size of its economy, finds the latest World Bank report called Europe 4.0: Addressing the Digital Dilemma. The country's AI adoption compares to the one in Malta, Estonia and Cyprus, although countries in the EU14 dominate the AI landscape.



## Quick facts from our analysis:

- ✦ There is a clear increase in the number of companies interested in using AI to create innovative solutions that can positively impact Bulgarian society;
- ✦ Bulgarian AI developers enjoyed significant revenue growth in the period 2019-2021. Their combined total revenue reached a record-high of 25.7 million in 2021, a jump of more than 35% from the amount in 2019. Compared to 2020, the sector reported EUR 3.8 million more revenue in 2021 than the previous year, representing a solid annual growth rate of 17.3%;
- ✦ Bulgarian entrepreneurs have a strong presence on the local AI scene, as 70% of the companies in the area are solely owned by Bulgarian individuals or companies;
- ✦ There is an upward trend in the number of employed specialists in the field, a record-high annual growth rate of 25% was reached in 2020;
- ✦ According to official data, in 2021 nearly 40% of those employed in the sector were engaged in research and development, up from 29% in 2020;

# Regulations and Strategic Frames

## Plan for Digital Transformation of Bulgarian Industry

Bulgaria's Council of Ministers approved in July 2020 the strategy paper 'Plan for Digital Transformation of Bulgarian Industry (Industry 4.0)' as a precursor for the strategy for Bulgaria's participation in the fourth industrial revolution up to 2030. A working group with representatives from the Ministry of Economic Affairs, the employers' organisations and the ICT sector is finalising the document. Its measures and objectives will provide a basis for developing the country's SME strategy and the Research and Innovation Smart Specialisation Strategy (RIS3), with digitalisation being a cross-cutting priority in both strategic documents. The strategy paper sets out three priorities:

- strengthening the science-industry link and speeding up integration into European and international programmes, in line with developing and implementing Industry 4.0;
- promoting technological innovation in the Bulgarian economy;
- building human, scientific, organisational and institutional capacity for the development of Industry 4.0 in Bulgaria;

## Digital Bulgaria 2025

Digitising Bulgaria's industrial sectors and developing a data-based economy is one of the goals in the national programme 'Digital Bulgaria 2025'.

Supported by EU structural funds, the programme outlines measures to encourage the digitisation of businesses. EU funds are allocated to four centres of excellence and nine centres of competencies specialised in areas including mechatronics, clean technology and informatics. In parallel, another EU-funded project will support the creation of regional innovation centres for cooperation between businesses and research centres. These projects' sustainability and performance are vital for future investment in terms of infrastructure and soft measures.

The Ministry of Education and Science has recognised the laboratory complex at Sofia Tech Park as a nationally significant infrastructure. Accordingly, it has allocated EUR 485,000 for 2019-2020 to its 11 high-tech labs, which work in areas including AI, HPC and biotech. Bulgaria is a founding member of the EuroHPC Joint Undertaking. Sofia Tech Park will be hosting a Petascale supercomputing system with the support of the Ministry of Economic Affairs. A 6 petaflops supercomputer will be positioned in Sofia Tech Park following EuroHPC project implementation, one of the five petascale supercomputers to boost Europe's computing power. After its launch, Bulgaria will become a regional digital hub.

## Digitisation in agriculture

In May 2019, Bulgaria adopted a strategy for the digitisation of agriculture and rural areas including measures based on AI and Blockchain. The strategy envisages the use of AI to track production, protect against pests, create a continuous farm-to-table chain, and ease farmers' administrative burden. In 2019, the Bulgarian Academy of Sciences drew up a framework for a national strategy for AI in Bulgaria by 2030 and submitted it to the Council of Ministers in July 2019. It identifies healthcare, public services, smart agriculture, animal husbandry and environmental protection as areas for AI implementation in Bulgaria. The technological areas with potential for the development of AI-based products and services include:

- robotics,
- AI in developing (and testing) software,
- human-machine interfaces in natural language,
- security systems,
- critical resources and infrastructure.

## UniCredit Bulbank aids business analysis with new digital feature



**Mr. Keremidchiev, UniCredit Bulbank recently launched a new functionality for its corporate clients. Can you tell us a bit more about it?**

Yes, In July we activated a brand new functionality in Bulbank Online, which is now available in the menu Digital Products in the digital banking for all legal entities, clients of the Bank. The new functionality gives our clients the opportunity to see the dynamics of twelve key financial indicators of companies, presented in a handy

and intuitive graphic style, as well as the option to generate comparative analysis on those KPIs, with the performance of the top five competitors in the same or different sector, by chosen criteria (i.e. size of the company, turnover). In this way, our clients have access to useful summaries of the information from the annual financial statements, as well as a fast and easy way to compare with other market participants or to research the reliability and potential of new clients, partners and distributors. Beyond

this, the new functionality supports our clients in discovering new potential opportunities for expanding their business in different sectors by providing average KPI's for the sector, top performing companies, sector analysis, etc. Currently, the access to the service is exclusively available without charge to all legal entity clients of UniCredit Bulbank, so those interested can register in order to test it for free. Our main goal now is to receive the opinion of our users and to further enhance and shape our platform, based on their feedback. We are living in fast-paced digital times and for us, as a financial institution, it is a strategic focus to meet and even exceed clients' rising expectations and to offer propositions and experiences that are smart and customised.

### **How was AI deployed with respect to this particular functionality?**

AI is considered as one of the technologies that is fundamentally changing the financial industry. The new functionality – Digital products, is based on smart algorithms, comparative analysis and graphic representation of the collected data. This is just the initial stage of the enhancement of our digital banking offering - Bulbank Online as a virtual ecosystem. In the next months we will further expand the options with new functionalities where Robotic process automation (RPA) will be applied, in this regard AI will help to provide a deep instant analytical picture. Our plans are to develop the section with the ability to quickly process large amounts of data and predict the latest market and consumer trends. Using advanced machine learning techniques will guide us to provide data that evaluate market sentiments and behavioural traits. This can only lead to higher quality of services, more responsive suggestions and will make the functionality even more attractive for our clients.

### **What is the current scope of the new functionality and do you plan to expand it?**

The current functionality – menu Digital products, includes two sections: Client analysis and Industry analysis. In the future it will cover customer behaviour profile and ever more functionalities including cash management flow, forecasting and even more. By enabling access to a diverse set of data through a common access point – Bulbank Online, we are providing a complete digital ecosystem to transform the way our clients evaluate and develop their own businesses. Based on focus interviews with

our clients, we understand better their needs, expectations and their behaviour. This enables us to customise the new services by adding sought-after features and intuitive interactions to deliver meaningful customer engagement.

### **The banking sector is no exception to the demand for increased digitization and smart decisions that aid corporate clients in their decision-making process. Does UniCredit have an in-house AI team and do you plan to develop further your capabilities in that area?**

According to a study by Intone Networks, AI has positively transformed the banking and the financial services industry in different fields from credit decisions to securities trading and fraud detection and prevention. We have multiple departments engaged and working on the digital development and the digital intelligence of the Bank, which are maturing every day, and bringing the potential for higher-complexity solutions that generate positive feedback. Therefore, we cannot say that our digitization units are focused on one thing and only on one functional area.

We invest in the culture of digital understanding across the organisation. We always try to find new opportunities in the digital world and ensure optimal client experience and satisfaction in order to build long-term relationships, partnerships and customer loyalty. We are aiming to use more and more AI software to detect even the slightest movement on the market, because every company needs to analyse every single transaction in large data sets. With the help of AI this is possible and we further improve our capacity to plough through mountains of data in a short time and, with precision, flag anomalies that aid in risk assessment and mitigation.

Although we still face operational and organisational challenges, with which we are making great strides in terms of implementation and adoption, we are also discovering the beauty of it all during the process of discovery and elaboration. Moreover, we will continue to build the technological foundations and processes necessary to move forward into the future, because without digital solutions, we would not even get close to the level of data analysis we are at right now.

## Digital in Bulgaria's Recovery and Resilience Plan

The total budget of the Bulgarian Recovery and Resilience Plan is nearly EUR 6.9 bln, of which EUR 6.3 bln will be financed in the form of non-repayable grants by the Recovery and Resilience Facility. The plan is overall composed of twelve components, in four policy pillars: 1) Innovative Bulgaria, 2) Green Bulgaria, 3) Connected Bulgaria, and 4) Fair Bulgaria.

Digital challenges for Bulgaria are related to insufficient connectivity through very high-capacity networks, low offer and uptake of digital public services, low level of digital skills and limited uptake of digital technologies by enterprises.

### Key measures for the digital transition

Bulgaria's recovery and resilience plan supports the digital transition with reforms and investments aimed at increasing the coverage of very high capacity networks across the country, including in rural and sparsely populated areas (EUR 270 mln); enhancing the digital skills of the population (EUR 319 mln); improving the digitalisation of public administration and the provision of digital public services in key areas such as justice, postal services, health, employment and social protection (EUR 297 mln); supporting the digitalisation of businesses (EUR 15.7 mln), as well as of the transport (EUR 202.6 mln) and energy sectors (EUR 75.7 mln).

Example project: Large-scale deployment of digital infrastructure

Bulgaria plans to invest substantially (EUR 270 mln) in the widespread availability of very high capacity networks throughout the country. The project will aim to upgrade and extend the coverage of the state network to all municipal centres and provide coverage with VHCNs in areas where this infrastructure is unlikely to be developed soon due to the lack of market interest ("white areas"). This will contribute to reducing the urban rural divide and to creating prerequisites for equal access to high speed connectivity services for all citizens.

## AI National Strategy

On 19 August 2020, the Bulgarian Ministry of Transport, Information Technology and Communications released a new draft strategy entitled Concept for the Development of Artificial Intelligence in Bulgaria until 2030. It aims to define focal areas for building scientific and expert capacity for the development and implementation of AI systems and to build on the measures and activities set as a priority in other relevant national strategic documents, including in particular "Vision, Objectives and Priorities for the National Development Program: Bulgaria 2030."

The main impact areas and measures that are envisaged are:

- ✎ Building a reliable infrastructure for AI development, which entails data collection and sharing in the private sector, among others;
- ✎ Development of research capacity for scientific excellence through enhanced international scientific cooperation and science-business relations and the creation of a Bulgarian centre of excellence in AI;
- ✎ Creation of knowledge and skills for the development and use of AI, including vocational training, retraining and lifelong learning;
- ✎ Support for innovation in order to implement AI in practice by kick-starting a number of projects such as 'Living Labs' targeted at SMEs and real-time data transmission platforms that could be especially beneficial to the agriculture and e-health sectors;
- ✎ Raising awareness and building trust in society regarding AI by creating new communication channels and stimulating the active sharing of good practices and success stories;
- ✎ Creating a regulatory framework for the development and use of reliable AI in accordance with international regulatory and ethical standards; this will begin with an initial evaluation of the applicability and effectiveness of existing regulatory measures;
- ✎ Creating conditions for financing and sustainable investments for the development of AI using national and EU funds.

## Concept for the development of AI in Bulgaria until 2030

In June 2020, a team of representatives of the Bulgarian Academy of Sciences (BAS), together with external experts developed a draft document on the development of AI in Bulgaria until 2030 called "Artificial Intelligence for Smart Growth". The Concept offers a comprehensive vision for the development and use of AI in Bulgaria. It is based on the strategic and programming documents of the European Commission, which consider AI as one of the main drivers of digital transformation in Europe and a significant key factor in ensuring the competitiveness of the European economy and a high quality of life.

The Concept outlines the main prerequisites and challenges for the development of AI in Bulgaria for the period 2020-2030. It also includes an overview of existing strategies and projects for the development of Bulgaria in the coming years

Bulgaria is a signatory to the Declaration of Cooperation on Artificial Intelligence.



## GATE Institute cultivates the next generation of leading scientists

GATE Institute is the first dedicated Big Data and AI Centre of Excellence in Eastern Europe co-funded by the EC and the Bulgarian Government and established as a joint initiative with Chalmers University of Technology and Chalmers Industrial Technologies, Sweden. Having the vision to enable a Data-Driven Smart Society, GATE is facilitating digital transformation by leveraging the opportunities that Big Data and AI technologies create and by accelerating their impact across society. GATE performs research and creates innovations in four application domains – Future Cities, Digital Health, Smart Industry and Intelligent Government.

GATE develops research capacity and potential in Big Data and Artificial Intelligence, cultivating the next generation of leading scientists by building a vivid research network and establishing strategic long-term collaboration with leading global organizations. By providing advanced infrastructure - platform, data, services and testing and experimentation facilities, GATE aims to be the recognizable national Data Space with credible potential. Enabling AI-driven technological collaboration between government, industry and academia, GATE is the heart of a vibrant data-sharing ecosystem to provide value for its partners and members.

GATE also aims at a more democratic and widespread AI, building on novel decentralized ML algorithms that can cope with distributed collectives of local models through federated learning and knowledge distillation, device-centric AI and ML crowd training. By combining ontological engineering models and semantic technologies with the specification of logical policies and constraints, GATE develops a new level of intelligence capable of dealing with both static and dynamic data in a variety of business domains.

In the Future Cities application domain, GATE is focused on City Digital Twins and Data Spaces as complementary technologies and innovative models. They enable smart data sharing, simulations, and data-driven and evidence-based decisions in many city aspects – air quality, urban planning and building, energy consumption, infrastructure, city transportation and logistics, mobility, etc.

Air quality monitoring is an important aspect of urban governance. High concentration levels of different gases and particulate matter can have an adverse effect on human health and the standard of living in urban regions. The existing air quality stations measure air pollutants at a finite number of locations, providing pointwise data with different granularity and quality. The GATE team is working on geospatial air quality analysis to provide a way of combining the information from different sensor stations and to develop a platform for the real-time prediction of air quality. To achieve this, methods from the field of uncertainty quantification and statistical learning are used, which enable the analysis of existing sensor data in a probabilistic way. The developed platform is envisioned to serve

several purposes, including the monitoring and prediction of data-based air quality metrics, the determination of the optimal placement of future sensor stations and the virtual surrogate for sensors during downtime.

In the Digital Health application domain, GATE research is focused on Alzheimer's disease. The Amyloid-Tau-Neurodegeneration (ATN) biomarker framework is a mean of evidencing the biological state of Alzheimer's disease and non-Alzheimer's pathophysiology. This novel definition of neurodegenerative states has operationalized the recent shift in interventional dementia trials from the syndrome stages of the disease to biologically defined preclinical states. The scalability of the ATN framework that is required for large interventional trials is limited by the availability, invasiveness and cost of the biomarker investigations. GATE proposes a prediction of ATN status through known risk factors and dementia scores, which addresses this limitation through empowering targeted recruitment via internet-based brain health volunteer research registers. The ATN prediction is granted by AI in the form of ML modelling relative to the best regression models. The rationale for this approach is the evidence that data-driven approaches such as ML can outperform classical statistical methods in the field of diagnostics. In addition, they can continuously 'learn' and improve over time as data accumulates.

Also, GATE is focusing on a new research priority area dedicated to studying online disinformation in the Balkans, as citizen susceptibility to conspiracies and misinformation in the area is among the worst in Europe. The team develops new AI methods for large-scale disinformation analysis in English, Bulgarian and other Balkan languages. A new regional multi-disciplinary alliance of researchers, fact-checkers and other experts has been established, to act and an amplifier of national and regional actions against disinformation.

GATE is the Bulgarian International Data Spaces Association (IDSA) Hub and the catalyst of national endeavour toward Data usage and Data sharing in both industrial and public domains. The IDSA and the Bulgarian hub are on a mission to create the future of the global, digital economy with International Data Spaces – a secure, sovereign ecosystems for data sharing, which all participants can realize the combined value of the data. GATE aims to be a driver for community engagement of businesses and public and city administrations and an enabler for the incubation and acceleration of innovations based on data sharing and utilization at the national and regional levels. The hub also facilitates IDS technologies adoption acceleration by providing technical expertise related to IDSA architecture and components application and implementation for the realization of industrial and public data spaces.

GATE is building an Urban Data Space for data sharing and for providing Data as a Service. It will support the development of a City Digital Twin of Sofia. The data is a key to informed decision-making, a valuable resource for innovation and development and a prerequisite for making smart urban decisions. The integration of public and private data, as well as citizens' data for environmental cleanliness, mobility, construction, energy efficiency, etc., is crucial to achieving sustainable cities. For example, by using City Digital Twins, "what-if scenarios" can be simulated, e.g., what is the effect of the air pollution on the surrounding environment and citizens' health or how to plan the city in order to be more walkable and more liveable. The utilization of data space and digital twin technologies allows the city to analyze air pollution, identify measures to optimize energy and natural resources usage, and improve housing and mobility.

# Ecosystem supporting AI

## Academia



## AI communities



## Government and Public Ecosystem



## Investment Ecosystem



# Bulgaria's First Petascale Supercomputer Creates Climate Change Simulations



Discoverer is Bulgaria's First Petascale Supercomputer that is currently ranked 113th in the TOP 500 world ranking of most high-performing machines. It is managed by Consortium "Petascale Supercomputer - Bulgaria" with leading partner Sofia Tech Park.



Petar Statev is the chairman of the Supervisory Board of Sofia Tech Park and executive director of the Consortium "Petascale Supercomputer - Bulgaria".

## **Mr. Statev, in what areas can the machine perform tasks and is there interest from business and scientific teams to use the machine's capacity?**

Discoverer has strongest capabilities, highest scientific and business interest and real demand in the areas of High Resolution Weather Forecasting and Environmental modelling, Computational Fluid Dynamics for flow and mass transfer simulations in complex geometries, Quantum Chemistry and Molecular Dynamic simulations in the areas of drug and new materials discovery, 3D reconstruction of satellites and drone images. These areas require a significant amount of high performance CPU calculations coupled with very fast network interconnect between the servers and very fast access to large high performance storage. We also invest time and resources in educating our current and future users, by providing free courses and materials on how to use our supercomputer. Petascale Supercomputer - Bulgaria participates in the EU Master Program in High Performance Computing (HPC) aimed to educate future HPC talent. This is critical for long term, sustainable

utilisation and usage of Discoverer, because without a growing community of people who know how to operate such infrastructure it will be underutilised and its impact will be limited.

## **What projects is the machine currently working on and what tasks does it solve?**

In all areas mentioned above we have running projects. Some of Discoverer's current work are projects that create simulations of the climate changes of extreme meteorological phenomena and study the propagation and emerging properties of an incipient short gamma-ray burst jet piercing through the environment surrounding an accreting black hole formed after a binary neutron star merger. Most of the projects come from the Bulgarian Scientific Community and from access calls from EuroHPC JU/PRACE. These are consequences of the way Discoverer has been funded – 65% by the Bulgarian government and 35% from EuroHPC JU, the organisation that manages and co-funds large HPC Infrastructure in the EU. For purely scientific and non-commercial projects Discoverer's resources are provided for free given that the applications pass the evaluation of international HPC experts. Projects are evaluated on their scientific merits, novelty and societal impact and all results need to be reported and published for public access. For a limited number of projects, which are of commercial interest, we are allowed to work with companies on a business to business basis, which means that access to Discoverer's resource is paid, but in return companies are allowed to commercialise their results and there is no publication requirement. We are allowed to spend up to 20% of our computational resources per year on such commercial projects. Discoverer is part of the EU wide EuroHPC Supercomputer Network, which currently consists of 5 other petascale supercomputers and 2 exascale ones. In the future these supercomputers can run in federation where users can get access to all of the resources depending on availability and suitability of the projects.

## **Technologies are constantly evolving, how will Discoverer, with the parameters it currently has, maintain its competitiveness?**

Currently, Discoverer has only a CPU partition, which though very powerful, is not suited for all types of applications, especially those in the areas of Machine Learning (ML) and Artificial Intelligence (AI). We are currently in the process of upgrading and in 2022 we plan to offer our customers access to accelerated GPU partition and to significant extension of our high performance storage. This will expand Discoverer's capabilities in the AI/ML space where we see significantly growing interest from both local and international academic and business customers. Another area where we plan to expand our capabilities is Quantum Computing (QC), where we will start offering access to simulators/emulators of quantum computers and to real QC afterwards. The reason we do not jump immediately to the QC bandwagon is that we want to build our local community and train future users how to work with QC and then we will invest in the hardware. This emphasises our belief that there are direct benefits of offering Discoverer's resources to local and international scientific and business communities and indirect benefits using the infrastructure to educate and train future talents. We believe that in the long run indirect benefits will outperform the immediate local ones.

## Zoom on Academia Ecosystem

The academic infrastructure in Bulgaria that can be used to solve important tasks in the field of AI will improve dramatically in the coming years due to the funding of nine major projects under the Operational Program “Science and Education for Smart Growth” (OP SESG) 2014-2020, ICT-related activities including AI, robotics and mechatronics - three Centers of Excellence, five Centers of Excellence and one for complementary support of the GATE project, funded by Horizon 2020, Widespread-Teaming, Phase 2. Almost all Bulgarian research organisations and universities, in which research on AI is carried out and relevant curricula and doctoral programs are maintained, participate in these projects.

The role of STEM disciplines (sciences, technologies, engineering and mathematics), as well as the development of “soft” skills (organisational qualities, teamwork skills, etc.), significantly increases the development of potential, capable of developing and applying AI, along with digital skills. To this end, the Ministry of Education and Science is developing policies and tools to promote innovative teaching practices and methods (interdisciplinary teaching, project training, partnerships between the IT business and schools). A major part of the measures to be taken in this direction are set out in the document “Artificial Intelligence in Education and Science” (2020) developed by the Ministry of Education and Science, which also focuses on higher education and research.

### *New bachelor degree for AI and Intelligent System was launched at the Faculty of Industrial Technology in Technical University of Sofia*

The Technical University - Sofia unveiled a new bachelor programme, “Intelligent Systems and Artificial Intelligence” which will begin in the fall of 2022. Students can choose to be taught in either Bulgarian or English. The program is developed jointly with Technical University - Gabrovo, Chemical Technology and Metallurgical University and Mining and Geological University “St. Ivan Rilski”.

The main goal is to prepare highly qualified and broad-profile specialists with solid general training and in-depth knowledge to develop new ideas in the field of intelligent systems and artificial intelligence.

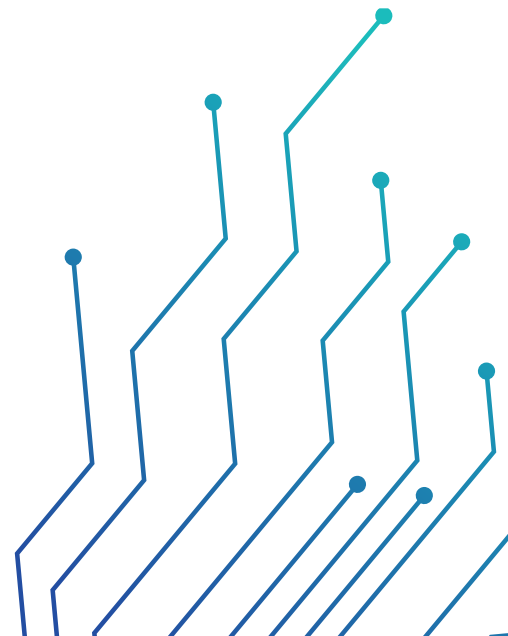
The programme is supported by Bosch Engineering Center Sofia.

### **INSAIT - Institute for Computer Science, Artificial Intelligence and Technology**

INSAIT has been created in partnership with ETH Zurich and EPFL Lausanne. The Chair of the Supervisory Board is ELLIS Fellow Martin Vechev, a leading scientist in the field of computer science and a Full Professor at ETH Zürich. The institute is structured as a special unit of Sofia University and is supervised and advised by world-renowned scientists from ETH Zurich, EPFL, IST Austria, MIT, UC Berkeley, Yale, Princeton, and the Technion. Thanks to investments from Google, DeepMind and AWS, and financial support from the Bulgarian government of almost USD 100 million over 10 years, INSAIT plans to build up world-class research and educational programmes. These programmes will comprise the foundations and applications of artificial intelligence and computer science, including machine learning, natural language processing, computer vision, information security, programming languages, formal methods, quantum computing, computer architecture, among others.

The objective of INSAIT is to establish a competitive research centre that will keep local talent in Bulgaria while also attracting outstanding international scientists to the region by offering top tier research facilities and remuneration. The establishment of this new institute marks an important step towards the ELLIS-endorsed concept of a multi-centric European AI lighthouse.

Investments in AI-based systems in research and higher education are also made through the Science and Education for Smart Growth Operational Programme (2014 – 2020), which supports the establishment of many Centers of Excellence and Centers of Competence, of which several focused on ICT-based solutions. OP SESG also provides the national co-funding for the “Big Data for Smart Society” (GATE) Center of Excellence, supported by the European Commission.



## Digital Innovation Hubs

Under the “Digital Europe” programme, the European Commission (EC) presented earlier in 2022 to the member states the evaluation of the projects under the first call for the creation of a network of “European Digital Innovation Hubs” (EDIHs), which will cover all regions of Europe.

“Digital Europe” is a new EU programme aiming to provide digital technologies and solutions for businesses, citizens and public administrations. European innovation hubs will support companies and public organisations’ access to technological expertise, experimental facilities, tested and proven technologies, specific knowledge, services, good practices, etc. EDIH will work in five priority areas: high performance computing, AI, cyber security, innovative digital skills and broad use of digital technologies in the European Commission economy and society.

The construction of the EDIHs supports the digital transformation of the European Union countries by investing in key areas such as AI, high-performance computing, cybersecurity, advanced digital skills, digitalisation of public administration and interoperability.

For the territory of Bulgaria, four project proposals have been approved, which will be jointly financed by “Digital Europe” and the “Programme for Scientific Research, Innovation and Digitization for Intelligent Transformation”.

EDIHs are intended to act as the European Commission’s contact point in supporting the implementation of specific sector policies, policies targeting enterprises (including SMEs, mid-caps, growth enterprises) and the public sector.

The fourth chosen Bulgarian EDIHs are:

- ↙ European Digital Innovation Hub Zagore
- ↙ Digital Construction Hub
- ↙ AgroHub
- ↙ Trakia Digital Innovation Hub

**The Digital Innovation Hub Zagore** is the largest cross-industry initiative in Bulgaria that aims to strengthen and anchor Bulgaria as one of the leading global locations for digital innovation. Under the umbrella of Digital Innovation Hub Zagore, led by the Regional Economic Development Agency – Stara Zagora, more than 25 association members and non-political foundation partners work

together to achieve this goal. The hub addresses all aspects of digitalisation and is committed to solving corresponding social, economic, and political challenges.

**AgroHub.BG** is the Bulgarian Digital Innovation Hub for agriculture. Established in 2019 as a non-profit non-governmental organisation, AgroHub.BG aims to bring together knowledge and resources for the agricultural industry in order to generate solutions to its problems and meet its needs. AgroHub.BG brings together representatives of various units of the agri-food chain such as end users, farmers and their associations, research units, educational institutions, IT companies, startups, manufacturers of machinery, equipment, technology, and other stakeholders such as local authorities, branch organisations and public institutions which are involved in decision-making processes for supporting and developing the agro-industry. The hub is putting efforts to make AI part of the farmers’ everyday life and business. Time Series Forecasting, Anomaly Detection and Probabilistic Optimisation are among the services provided for farmers by Agrohub.BG in order to help their decision making in different climate situations.

AgroHub.BG is also part of the European SmartAgriHubs network.

### Digital Construction Hub

The European Digital Innovation Hub in construction brings together the experience and expertise of the leading chambers and branch organisations in the country, universities, research organisations, leading construction companies, business incubators and innovation enterprises aiming to support the digital transformation of the Bulgarian construction industry. The hub aims to increase the competitiveness of the Bulgarian construction companies and grant them access to new markets and funding opportunities; facilitate network building and strategic partnerships on national and international level; foster digitisation and innovation for more effective construction processes; enhance the circular economy and resource efficiency in construction sector; support the industry by reskilling and upskilling of professionals in the sector;

Eight Bulgarian project proposals have been awarded the Seal of Excellence by the European Commission. These projects will also be able to apply for support through the 'Research, Innovation and Digitization Program for Smart Transformation'.

### European Digital Innovation Hub - Northwest Automotive Cluster Bulgaria

The Hub brings together partners with high strategic and technological expertise and the shared vision of transforming one of Bulgaria's most underdeveloped and impoverished regions (the Northwest) into a driving force on the Balkan Peninsula. Its main mission is to attract new investments from foreign and domestic high-tech industries so as to strengthen and accelerate the region's transition to Industry 4.0.

#### GOALS

- Improve manufacturing processes for businesses through process connectivity and real-time data exchange for integrated processes; system flexibility and adaptability to specific user needs; digital automation of repeatable processes for optimisation; sustainability through optimal use of resources for production;
- Develop and support the digitalisation and innovation capacities of both SMEs and public sector organisations, with a focus on manufacturing industries, especially the automotive sector.

## The Bulgarian Centres of Competence (CoC) and Centres of Excellence (CoE)

The Centres of Excellence and Centres of Competence were created with the aim to foster the development of the scientific and research infrastructure of Bulgaria funded under Priority Axes 1 of the Operational Programme Science and Education for Smart Growth 2014-2020. They are seen as hubs for high – quality research and innovation for priority areas of RIS3 in Bulgaria as well as complementarity investment for the implementation of the national target of investing 1.5 % of GDP in R&D.

Thirteen projects were funded under the Operational Programme – four Centres of Excellence (CoE) and nine Centres of Competence (CoC) should be operational by the end of 2023.

These centres aim to create the best possible conditions for attracting highly qualified researchers to conduct top level research at European scale in RIS3 priority areas and to significantly improve the potential for applied research, experimental development, and technological innovations. They encourage, among others, activities focused at the thematic areas defined in the innovation strategy for smart specialisation of the Republic of Bulgaria 2021-2027 (ISSS): mechatronics, informatics and ICT, healthy life industry and biotechnologies; new technologies in creative and recreational industries and clean technologies.

In 2021-2027 Bulgaria will receive more than EUR 10 billion under the European Commission's Cohesion Policy, with a substantial part dedicated to supporting innovation and competitiveness and green and digital transitions.

### National Centre for Mechatronics and Clean Technologies

The main goal of the Project National Centre for Mechatronics and Clean Technologies is to build and develop a modern research infrastructure that will contribute to the implementation of the programme for sustainable and smart economic growth of the Republic of Bulgaria.

#### The specific objectives of the project are:

- Creating a sustainable interdisciplinary Centre of Excellence, to take a worthy place in the European Research Area;
- Active search/demand for business relations and incubation of spin-off companies;
- Close interaction with the new Centres of Competence;
- Educating a new generation of young scientists, who will be trained for market-oriented science;
- Introducing the advanced achievements in the global science scene;
- Dissemination of knowledge to different target groups (scientific community, industry, trainees, society);
- Achieving a qualitatively new level of knowledge in several mutually overlapping economic segments - mechatronics and clean technologies, through the development of specific scientific methods and tools to achieve intelligent design, planning and operation of material resources, energy systems and mechatronic components;

Raising the qualifications of scientists and the improvement of the quality of engineering education next to the Centre will help to improve the innovative potential and technological level of enterprises and will promote the dynamics of innovative processes in Bulgaria.

**PARTNERS**

- Institute of General and Inorganic Chemistry – BAS (coordinator), <http://www.igic.bas.bg>
- Institute of Electrochemistry and Energy Systems “Acad. E. Budevski” – BAS, <https://iees.bas.bg/bg>
- Institute of Catalysis – BAS, <https://ic.bas.bg/>
- Institute of Metal Science, Equipment, and Technologies with Hydro- and Aerodynamics Center “Acad. A. Balevski” – BAS, <https://ims.bas.bg>
- Institute of Mechanics- BAS, <http://www.imbm.bas.bg/>
- Institute of Mineralogy and Crystallography “Acad. Ivan Kostov” – BAS, <http://www.imc.bas.bg/>
- Institute of Optical Materials and Technologies “Acad. Jordan Malinowski” – BAS, <http://www.iomt.bas.bg/>
- Institute of Organic Chemistry with Centre of Phytochemistry – BAS, <http://www.orgchm.bas.bg>
- Institute of Polymers – BAS, <http://www.polymer.bas.bg/>
- Institute of Solid State Physics – BAS, <http://www.issp.bas.bg/>
- Institute of Physical Chemistry “Acad. Rostislav Kaischew” – BAS, <http://ipc.bas.bg/>
- Sofia University “St. Kliment Ohridski”, <https://www.uni-sofia.bg/>
- Technical University of Sofia, <https://tu-sofia.bg>
- Technical University of Varna, <http://www2.tu-varna.bg>
- Technical University of Gabrovo, <https://www.tugab.bg/>
- University of Chemical Technologies and Metallurgy, <https://dl.uctm.edu/bg>
- Central Laboratory of Applied Physics – BAS, <http://www.clap-bas.com/>

**Website:** <https://www.cemct.eu/en/>

**Centre of Competence (CoC) “Quantum Communication, Intelligent Security Systems and Risk Management - QUASAR**

Center of Competence (CoC) “Quantum Communication, Intelligent Security Systems

and Risk Management - QUASAR” is part of the Bulgarian Academy of Sciences (BAS) and is located at the Institute of Robotics of BAS. Partners are the Institute of Robotics of BAS, Sofia University “St. Kliment Ohridski”, the Technical University of Gabrovo, the National Military University in Veliko Tarnovo, the Higher Naval Academy in Varna, the Institute of Nuclear Research and Nuclear Energy

of BAS, the Institute of Metallurgy of BAS, and the non-governmental organisation Advanced Flight Technologies.

CoC QUASAR is a cross-disciplinary scientific infrastructure in Bulgaria that is focused on training PhD students in the fields of quantum communication and technology, robotics, cyber-physical systems, artificial intelligence, intelligent security systems and risk management.

CoCQUASAR is the official representative of Bulgaria in the European initiative EuroQCI (European Quantum Communications Infrastructure) and will be coordinating the implementation of the first pilot quantum communication networks in the country.

**Website:** <https://www.news-quasar.bg/>



### Universities for Science, Informatics and Technology in an e-society (UNITE)

The UNITE project is a result of the ambition of many scientists working at partner universities in the country to achieve a common organisational structure that will assist in the implementation of new ideas, projects, research and their dissemination. The general framework of the consortium will allow joint participation in various initiatives of the Ministry of Education and Science (MES), applications for calls under H2020-funded research, research and infrastructure projects, EU Structural Funds, MES Funds and other funding organisations and institutions.

The main goals of the UNITE project team are to support the coordination of scientific and educational activities in computer sciences at the partner universities and to work actively for the development of information and communication technologies in the public interest.

As part of the project, a new Centre of Excellence (CoE UNITE) is to be established by 2023. The new Centre should meet the requirements for high-level scientific research in the priority area of the Innovation Strategy for Smart Specialisation (ISSS) - Informatics and ICT. The Centre will be of a Distributed Research Infrastructure (DRI) type.

#### PARTNERS

- Sofia University “St. Kliment Ohridski”;
- Technical University of Sofia;
- University “Angel Kanchev”, Ruse;
- University “Prof. Dr. Assen Zlatarov”, Burgas;
- University “Bishop Konstantin Preslavski”, Shumen

Website: [www.unite-bg.eu](http://www.unite-bg.eu)

## A Pan-European Network of Robotics DIHs for Agile Production

Sofia Tech Park is a partner in the DIH2 project for a pan-European network for the construction of flexible production and robotics. It is carried out by 37 partners in 28 countries, including 26 innovation centres and 10 companies providing operative expertise.

DIH2 is a network of 26 DIHs, with a target to reach over 170 DIHs until 2022. The goal is establishing a sustainable network of robotics DIHs, endowed with tools and procedures to facilitate the commercialisation and broad uptake of Agile Production by Manufacturing SMEs/Slightly Bigger Companies.

The project aims to reach more than 300,000 SMEs. For companies, the DIH2 consortium offers expertise and support in the area of agile production, including technologies, investments, standardisation, know-how and competences, as well as ethics and cyber security. Its main goal is to expand innovation by cutting costs of advanced robotics solutions and double growth of the robotics market.



# Zoom on AI Communities:

## AI Cluster Bulgaria

**Website:** [www.aicluster.bg](http://www.aicluster.bg)

**AI Cluster Bulgaria** is a professional non-governmental organization committed to building a sustainable ecosystem in the Artificial Intelligence sector. The Cluster is founded by specialists with years of experience in the field of Artificial Intelligence, as well as financial experts, investors, experts in patent law and intellectual property, PR experts and journalists, lawyers, specialists in ethics, experts working on national and European projects.

The Cluster's technology profile includes expertise in Artificial Intelligence, Machine Learning, Big Data and Data Science and their applications in the areas of Computer Vision, NLP, IoT, AR, VR, Client Modeling, Green AI, Cloud Computing and Networking & Interconnectivity - Smart Cities and more.

One of the objectives of the cluster is to equip the experts, students and enthusiasts with the ability and skills to analyze, design and develop computer systems and their applications. Therefore AI Club was founded at the beginning of 2020 in a collaboration with Sofia Tech Park. The focus of the regular monthly meetings will be on developing and strengthening systems thinking, problem-solving, analysis, design, research, teamwork and readiness for lifelong learning in areas of Artificial Intelligence, Machine Learning, and Deep-Learning.

A collaboration of different AI ecosystems bears many great advantages, the exchange of expert knowledge and the chance to brainstorm new, unique ideas are just two examples. Connecting a broader network together is also a step towards the goal to make AI available, approachable and understandable for all. In order to achieve this, Europe is in need for an ambitious and thorough strategy involving both business and the public administration, so the ideas and impulses can evolve into pragmatic socioeconomic opportunities.

The cluster successfully partners with a number of institutions and organizations, including, Ministry of Economic, BSMEPA, Sofia Municipality, BESCO (Bulgarian Startup Association), Bulgarian Investment Agency, GATE, Medical University-Plovdiv, Trakia University in Stara Zagora, EEN and others. The AI Cluster has built successful

collaborations with Health & Life Sciences Cluster and United Drone Association in order to stimulate and create high value cross industry projects.

The cluster is a member of the Advisory Board of BRAIT (Bulgarian Employers' Association for Innovation and Technology), together with Automotive Cluster, Mechatronics Cluster, BAIT, BASCOM, ICT Cluster and others. AI Cluster participates in the organization of the Pitch2Pitch series of entrepreneurship events in partnership with Premium Coworking Spaces, Impetus Capital, Innovation Capital, and a number of venture funds, business angel organizations and investment programs.

**AI Cluster Bulgaria** cooperates with related networks and clusters in Europe and abroad, which contribute to the experience and access to the AI sector.

The cluster successfully partners with a number of institutions and organizations, including, Ministry of Economic, BSMEPA, Sofia Municipality, BESCO (Bulgarian Startup Association), Bulgarian Investment Agency, GATE, Medical University-Plovdiv, Trakia University in Stara Zagora, EEN and others. The AI Cluster has built successful collaborations with Health & Life Sciences Cluster, United Drone Community Association in order to stimulate and create high value cross industry projects.

## International affairs of the AI Cluster Bulgaria:

### • Borderless AI Initiative

Recently the AI Cluster Bulgaria in a collaboration with AI Austria started an initiative for Borderless AI. Both organizations share the belief that Europe has the potential to be a global leader in innovation of data, which is the base of future sustainable economic growth and social well-being. We believe that by attracting and connecting all AI Clusters across Europe will be a perfect opportunity to exchange best practices and know-how, increase the level of innovations and develop paper recommendations for future policies.

### • European AI Forum

The AI Cluster is joint as a partner last December 2020 together with AI4SI, AI Austria, CroAI, Hub France IA and KI-Bundesverband. The Bulgarian AI ecosystem represented by the AI Cluster Bulgaria strongly supports the prospect of pan-European

large AI models. Our experts could contribute to the project and we express our willingness to join.

- **AI Alliance Bulgaria/Germany**

AI Bulgaria and the KI Bundesverband have sought an alliance to drive developments in the field of Artificial Intelligence (AI). The associations aim to explore the potential for bilateral cooperation in various fields of AI and aim to find solutions for international issues that are of common concern on a European Scale. By teaming up, the opportunities of AI in business and research can be fully ensured, while the challenges can be dealt with collectively.

The project concerns the necessity of direct cooperation between the Bulgarian and German AI-ecosystem consisting of startups, SMEs, VCs and research. In a Data-Driven ecosystem, it is of uttermost importance that cooperation is made possible on every level.

## Major AI Projects:

### Drones & AI LABs

The Drones & AI LABs international project was created at the end of 2020 with the signing of a memorandum between the United Drone Society Association, the Artificial Intelligence Cluster and the Emerging Technologies Integration Cluster. The mission of Drones & AI LABs is the creation of an effective, sustainable and highly conducive communication environment, favouring the easy exchange of information, the development of strategic partnerships and the implementation of joint multidisciplinary projects in the field of drones, artificial intelligence and their combination with other technologies. Currently, the partner network includes over 50 organizations from academia, business, state administration and local self-government.

### Robo & AI Innovation Valley (RAIV)

Robo & AI Innovation Valley (RAIV) is an innovation virtual hub for robotic and industrial AI technology research and development in the heart of the SEE region. The Hub aims to support AI & robotics - developers, - service providers and - system integrators in getting (their) novel technology developed and brought to market in line with the needs of the end users.

The RAIV will be a focal point of the academic commitment to industry collaboration, innovation,

and skills in an established and continually expanding area of expertise by providing a hub which adds value to the innovative ecosystem.

Institute for Quantum Technology next to the AI Cluster

The Institute for Quantum Technologies is composed of a multidisciplinary group of researchers from the fields of computer science, mathematics, chemistry, and physics. The Institute will research applications of quantum technology, advances and current state of quantum hardware and algorithms/programming languages.

Quantum technology is among the most expansive and challenging technologies of our time. To meet this challenge, the AI Cluster bring together scientists, engineers and industry in an inspiring environment. We are creating the quantum future because we believe that quantum technology can improve the state of a number of social and economic sectors, including health, security, agriculture and climate change.

### Health & Life Sciences Cluster

**Website: [www.biocluster.bg](http://www.biocluster.bg)**

Health & Life Sciences Cluster Bulgaria ([www.biocluster.bg](http://www.biocluster.bg)) is a professional nonprofit organization that unites businesses and organizations with Key Activities focused on practical application of life sciences & health. Innovative companies in the field of drug discovery, genetic research, 3D human tissue printing, software solutions for medical and outpatient care, drug manufacturing, nutrition supplements, green technologies, bio-based technology, foodtech, agritech and many more. The cluster participates in the Management Board of the Bulgarian Bioscientific Society and in the Management Board of the Bulgarian Employers' Association for Innovation and Technology ([www.brait.bg](http://www.brait.bg)), which is legal successor of the Bulgarian cluster association), together with Automotive Cluster, Mechatronics Cluster, BAIT, BASCOM, ICT Cluster and others.

The Cluster is a Member of EuropaBio (<https://www.europabio.org/>), Europe's largest and most influential biotech industry organization, CERB (<https://www.cebr.net/>), ECHAAlliance ([www.echalliance.com](http://www.echalliance.com)), ECCP (<https://clustercollaboration.eu/>), DIH.Net and has a strong support and partnership with local authorities, European representors (Maria Gabriel, Eva Meydel, Emil Radev, Ray Pinto among the others), international partners such as Oxentia ([www.oxentia.com](http://www.oxentia.com)), Deep Knowledge Group: DKG ([www.dkv.global](http://www.dkv.global)), etc.

The cluster's strategy envisages the establishment of representative offices in different regions in Bulgaria, guaranteeing cross-cluster, cross-industrial and cross-regional cooperation for SME development. One of the objectives of the cluster, that united our members is to stimulate, validate and promote technological progress in the sector of health & life sciences, as well as to connect scientists with business leaders, academia and media. For sure our members can take advantages of the services and main projects, such as building a sustainable regional innovation ecosystem, searching and establishment of collaboration opportunities in EU and International Projects with focus over the Green Deal, Horizon Europe, and creation and participation in a first of its kind in Bulgaria BioCenter (positioning in Sofia). The Center is in a result of successful collaboration with Health & Life, Sciences Cluster Bulgaria, Sofia Tech Park and Sofia Municipality, through Sofia Development Association. The establishment of the Center is expected to strengthen the ties and create new partnerships between the academic, research, industrial and regional community as a condition for the development of specific regional and local innovation ecosystems in Bulgaria.

By being a small country, allow us to know each other and build a strong ecosystem. Some of the Members of the cluster are also cofounders of AI Cluster Bulgaria ([www.aicluster.bg](http://www.aicluster.bg)), who has a strong international partnership. Being a Member of the European AI Forum (together with AI4SI, AI Austria, CroAI, Hub France IA and KI-Bundesverband), Health & Life Sciences Cluster Bulgaria can contribute with the creation of a strong collaboration with European AI Community. We look forward to engaging with the European Commission and all stakeholders in the process of implementation of the EU IP Action Plan for securing and broadening the criticality of IP for a successful life sciences and biotechnology ecosystem in the EU. The current fragmentation of European data repositories and data protection rules are making it hard for industrial players to use sensitive health data. The implementation of the European Health Data Space aims to address the challenges regarding the collection, use, re-use, interoperability and cross-border movement of high quality health data in a secure environment.

### **Cluster of Microelectronics and Industrial Electronics Systems**

**Website: [www.cmies.eu](http://www.cmies.eu)**

The Cluster of Microelectronics and Industrial Electronics Systems (CMIES) is an association of the stakeholders in microelectronics and electronics applications.

### **Mission of the Cluster**

To facilitate the links between the stakeholders towards enhancing the competitiveness of the Bulgarian ecosystem of microelectronics, nanoelectronics, and industrial electronics.

### **Objectives of the Cluster**

- Dissemination

Dissemination of information between the stakeholders in the sector and increasing the public awareness of their achievements.

- Competence building

Human resource and competence building in microelectronics, nanoelectronics, and industrial electronics.

- Research & Development

R&D, business development, and promotion of innovations in micro- and nanoelectronics and industrial electronics.

### **KRIB - Confederation of Employers and Industrialists of Bulgaria**

**Website: [www.krib.bg](http://www.krib.bg)**

The Confederation of the Employers and Industrialists in Bulgaria – KRIB is the biggest nationally representative business and employers' organisation in Bulgaria which produces three quarters of the GDP of the country, provides for over 800 000 jobs, unites over 12 000 companies through collective and individual membership and accounts for more than three quarters of the exports of Bulgaria. KRIB has the role of a major social partner and thus contributes to the economic development and sustainability of the social and economic relations in Bulgaria.

### **United Drone Community Association (UDC)**

United Drone Community Association (UDC) is a Bulgarian non-profit organization that aims to foster safe integration and efficient operation of unmanned aircraft systems (drones) in the airspace. It emphasizes on safety, security, data protection and privacy, and environmental issues. To achieve its objectives, the Association aims at facilitating a broad dialogue between public institutions, academia, technical, legal and business communities, through sharing experience and providing expert assistance.

In six years, the Association developed a series of successful workshops, educational sessions, demonstrations and awareness campaigns, and provided analytical work on the legal, technical, aviation, social, cultural, economic and ethical aspects. It gained recognition for its all-round strategies to promote the safety use of drones among the general public.

Drone ARENA is the most successful project of UDC. It spans across Central and Eastern Europe and aims to promote the use of drones by showing their capabilities via demonstrations, competitions, public lectures, training seminars, participation in forums, development of special purpose drones, finding new applications for drones and drafting rules on safety and security. UDC attracts experts in various fields related to emerging technologies and remotely controlled and autonomous systems, which allows Drone ARENA to provide for wide variety of topics and channels for delivery its key messages. The project has gained valuable Bulgarian partners, such as Drone Extreme (the first sports drone club in Bulgaria), LIBRe Foundation, AI Cluster Bulgaria, the Bulgarian Federation of Aircraft Modeling, etc. On international level, Drone ARENA is supported by FAI (World Federation of Air Sports - Fédération Aéronautique Internationale) and MultiGP (the world's largest league for drone racing, which seeks to make this sport accessible to all). So far, the project has organized over 70 events throughout Bulgaria and abroad and trained over 4,500 children and adolescents in the field of safe drone operations.

Drone ARENA initiatives led to the development of SEEK3R and MINI SEEK3R, based on the integration of drone technology and the possibilities offered by artificial intelligence. Their main purpose is to demonstrate the capabilities of both technologies in solving problems related to site searches, building inspections, and autonomous flights.

**Contact:**  
**Anton Puliyski**  
**Chairman & Legal Department**  
**United Drone Community Association**  
**[www.udc.bg](http://www.udc.bg)**

**Bulgarian Innovation Forum (BIF)**  
**Website: [www.innovationforum.bg](http://www.innovationforum.bg)**

Bulgarian Innovation Forum (BIF) is a unique platform for joint work that offers exceptional opportunities for leadership and innovative thinking, aiming to unite innovators, financial institutions, start-up projects, representatives of business, science, politics and civil society.

BIF was established in March 2022 in Sofia, uniting over 40 innovators and investors. There are 4 working groups that have developed specific recommendations and proposals in a very short period of time. They became the basis of the five flagship initiatives of NEIP (The New European Innovation Plan). These are attracting private investment in venture capital funds, building a

strong talent base, connecting local ecosystems, the need for experimental spaces for innovators, the need for a database for the preparation of innovation policies.

**Bulgarian Employers' Association Innovative Technologies - BRAIT**  
**Website: [www.brait.bg](http://www.brait.bg)**

Bulgarian Employers' Association Innovative Technologies (BRAIT) is a successor of the Association of Business Clusters, established 2009.

BRAIT aims to contribute to the development and strengthening of its members as organizations of high value-added industrial sectors related to innovative technologies in various sectors. The organization has the ambition to harmonize cluster policies and work to improve the economic development of its members in partnership with the government and state institutions.

The initiators for the establishment of BRAIT are organizations from the most important industries in Bulgaria: Automotive, IT, Education, Energy, Furniture, Maritime and Healthcare.

**LIBRe Foundation**

LIBRe Foundation (Bulgaria) covers research and consultancy work in technology law and related policy, ethical, and social issues in data governance, privacy and (cyber) security, e-commerce, e-government, e-justice, automation and autonomous systems, artificial intelligence, etc. With over 90 projects in technology law, security, and data protection, LIBRe Foundation converts its interdisciplinary experience in information technologies, organisational behaviour, and law, into strategic and legislative proposals, and large-scale projects with national and EU significance.

**Institute for Market Economics (IME), Bulgaria**  
**Website: [www.ime.bg](http://www.ime.bg)**

IME is the first free market Bulgarian think tank established in 1993 with the mission to advocate free market solutions to challenges citizens of Bulgaria and the region face in reforms.

IME goals are to provide independent assessment and analysis of the government's economic policies and to be a focal point for an exchange of views on market economics and relevant policy issues. IME main programs are:

- Regional development program – advocates for more freedom for regional governments since there are huge differences and one-size policy is not an option to boost local growth.

- Legal program – advocates for judiciary reform towards independence, rule of law and accountability.
- Business environment program – monitors and assesses regulations, prepares recommendations and participates in public discussions.
- Fiscal program – monitors, analyses and comments on the state budget with the goal to reduce spending and increase its efficiency.
- Labour market program – advocates for less regulations and more personal freedom.
- Knowledge program – maintains IME Economic Library with the goal to attract free minded people, educate interested young people and be a place for discussions.

IME is the only think tank in the country that combines economic and legal expertise and managed to advocate, formulate and assist in the implementation of several huge economic reforms in Bulgaria.

IME challenges people to think about the proper role of institutions, property rights and the rule of law in creating a society that fosters innovation and entrepreneurship.

IME team is very active in media and public discussions, often presenting alternative, free market point of view.

### **Emerging Technologies Integration Cluster**

The Emerging Technologies Integration Cluster (ETIC) is an organization, focused on creating an environment for facilitated integration of emerging technologies (AI, Robots, Drones, IoT, 3D printing, etc.).

Clusters' objectives:

- Overall support of the processes of integration of emerging technologies in society in ethical, legal, social, cultural, economic, technological and environmental aspects, with a focus on security, safety, privacy and protection of personal data and identity of each of the participants in these processes and increasing their technological culture;
- Building trust in the application of emerging technologies and creating habits for personal and social discipline regarding the safety of their integration and operation in various social processes and business areas;
- Assisting the process of building a technological culture in state institutions, academia, business and the general public by developing and promoting policies, strategies, good practices and codes of ethics related to measures and tools for regional and national economic and social development in

the field of emerging technologies;

- Initiating, supporting and conducting activities for the implementation of scientific and applied research, studies, initiatives, programs and projects in the field of emerging technologies integration in various social areas and the adaptation to certain technological changes;
- Supporting the process of raising the interdisciplinary awareness of state institutions, academia, business and the general public about the potential opportunities and possible risks in the integration and exploitation of emerging technologies.

Partners network: United Drone Community Association, LIBRe Foundation, AI Cluster Bulgaria, Health & Life Sciences Cluster Bulgaria, Sofia Tech Park, The University of Library Studies and Information Technologies, Technical University of Sofia, Biofeedback center - InWave, Groworking Space @ Sofia Tech Park

**Contact:**

**E-mail: [info@etic.bg](mailto:info@etic.bg)**

**Site: [www.etic.bg](http://www.etic.bg)**

### **BESCO – The Bulgarian Startup Association**

**Website: [www.besco.bg/bg](http://www.besco.bg/bg)**

BESCO is a non-governmental organization that acts as a bridge between startups, private and institutional investors, the government and other stakeholders in the innovation industry.

BESCO believes that a course set towards added-value activities based on research and development, innovation and entrepreneurial inspiration will shape our economy.

The Mission of BESCO is to upgrade the current Bulgarian legislation and propose contemporary market-driven policies based on innovation and progressive thinking.

### **Premium CoWorking Spaces**

**Website: [www.networking.space](http://www.networking.space)**

Situated in Bulgaria, Networking Premium is a chain of coworking spaces where ideas flow and businesses grow.

The concept of coworking revolves around the idea that people with different career paths get to share a workspace and explore the countless possibilities to interact with each other. We believe that one's environment is pivotal for every aspect of their own development and therefore, our aim is to create a vibrant coworking space where you

meet whatever you need. With five coworking areas in the heart of Sofia we want you to immerse yourself in the enchanting and differently themed atmosphere of each location, where we made sure that you would have the opportunity to rest as efficiently as you work.

In addition to that, we have also opened one location in the center of our cultural capital - Plovdiv. As we believe that rest is as important as work, even more so, we built The Villa - a spacious venue in Sofia's outskirts, which enjoys not only the comfort of every guest amenity available at our coworking areas but also provides numerous entertainment benefits in the specter of team buildings, pool parties, jam sessions and many more.

We love what we do, knowing our network grows as beautifully as our family members flourish.

### **Fintech Association**

**Website: [www.fintechbulgaria.org](http://www.fintechbulgaria.org)**

The Bulgarian Fintech Association is a non-profit organization uniting the leading fintech companies in Bulgaria. The mission of the Association is to create a platform bringing together all parties in Bulgaria with an interest in Financial Technologies and to encourage the communication and exchange of ideas among them.

The Bulgarian Fintech Association aims at representing and safeguarding the shared values of its members before regulators, investors, financial institutions, foreign associations, partners and any other party and thus, to foster the development of the sector.

### **Automotive Cluster**

**Website: [www.automotive.bg/about-us](http://www.automotive.bg/about-us)**

Automotive Cluster Bulgaria (ACB), founded in July 2012, is a non-profit organization which represents the interests of automotive manufacturers, suppliers, and organizations that provide services for the automotive industry. It fosters synergies between the cluster members and supports their business growth and competitiveness through participation in international joint projects, case studies, and professional automotive qualification programs.

AKB currently consists of over 250 nationally and internationally recognized automotive companies in the country, which have over 67,000 employees in Bulgaria and over 1.5 mln employees worldwide.

### **Digital National Coalition**

**Website: [www.digitalalliance.bg/en-home](http://www.digitalalliance.bg/en-home)**

The Digital National Alliance (DNA), launched in June 2014, has been recognised as the National Coalition for Digital Jobs in Bulgaria. The main aim of the DNA is to ultimately get more young people trained on digital skills.

The Digital National Alliance stands for diverse initiatives that aim at:

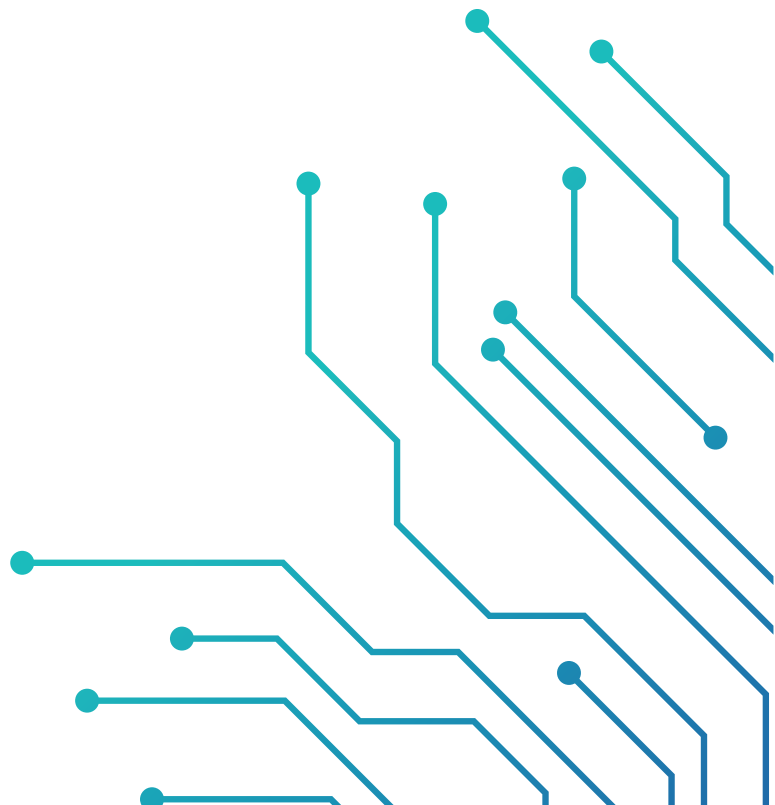
- Ensuring that more Bulgarian people have digital skills
- Addressing the mismatch between business needs and education requirements
- Supporting the Bulgarian young talents in the Global Digital Worldwide Stage
- Facilitating young people to access digital technologies and use them to communicate and co-create with people across Europe
- Helping young people to find new job opportunities.

### **Data Science Society**

**Website: [www.datasciencesociety.net](http://www.datasciencesociety.net)**

Data Science Society is an international digital community and our team has been building a strong core of members digitally around a body of Data Science knowledge while having fun!

So far Data Science Society has organized multiple Data Science Meetups and International Datathons with attendees from more than 20 countries. The organisation devotes ourselves also to their own Data platform for all enthusiasts, data geeks and experts who love to share their knowledge and learn more in the field!



# Zoom on Government and Public Ecosystem:

## Ministry of Education and Science

The Ministry of Education and Science is responsible for policy development and implementation in the field of education and science, as well as partially in innovation and technological development, mainly concerning skills, knowledge transfer and diffusion, among others. Digital transformation requires focus on both basic and advanced digital skills, as identified in the European Skills Agenda. Thus, the Ministry of Education and Science has a key role in the overall digital transition process, incl. regarding AI.

The field of education and science is related to reforms at all levels. The Ministry of Education and Science (MES) is actively updating the curricula and policies for ICT-related research funding. Digital skills training is already starting in primary school, and computer science has a stronger focus in secondary education. The opportunities for teaching informatics in higher education, including through distance learning, are expanding. AI will contribute to the modernisation of education and training systems. Currently, activities for the creation and maintenance of a cloud environment for the provision of smart educational services, as well as for implementation and development of modern flexible content platforms in support of preschool, school and higher education and lifelong learning that use modern ICT are being implemented.

The Ministry is also investing in establishing research capacity in AI and nation-wide collaboration between research teams and organisations, which could have the potential to participate in European and international R&I projects and initiatives. An example here is the “ICT in Science, Education and Security” National Research Programme (2018/2021), which provides funding for both research and networking activities and promotes the involvement of young researchers.

The MES invests in the establishment and development of research infrastructures under the National Research Infrastructures Roadmap. Most of them rely on AI-based systems for conducting research. One of them, however, has a horizontal role in supporting the research community, industry and the rest of the research infrastructures. The National Centre for High-performance and Distributed Computing, which consolidates and

coordinates the computing resources of IICT-BAS, Sofia University and Technical University – Sofia, provides various general and specific services, as well as training. The Ministry also develops and implements policies on Open Science (incl. open research data), researchers’ careers, young researchers’ skills, etc.

The Cluster’s technology profile includes expertise in Artificial Intelligence, Machine Learning, Big Data and Data Science and their applications in the areas of Computer Vision, NLP, IoT, AR, VR, Client Modeling, Green AI, Cloud Computing and Networking & Interconnectivity - Smart Cities and more.

## Ministry of Innovation and Growth

Important aspects of the Ministry’s policies are stimulating investment activity and accelerating export growth, encouraging investment in technological and innovative industries, positioning Bulgarian companies on international markets, supporting innovative start-ups and technology transfer. Some of the means to implement these policies are more effective coordination and precise focus of institutions and financial mechanisms in support of small and medium-sized businesses and increased competitiveness, with a special focus on innovation and exports; the establishment of an Innovation Board and the improvement of cross-sectoral and inter-institutional coordination in terms of innovation and technology penetration into all sectoral policies; stimulating legislative reforms to attract private investment in R&D, commercialisation of high-tech products, value-added chains and access to business to e-services and financing.

The ministry is also aiming to foster a favourable environment for attracting investments, creating and applying innovations, improving Bulgaria’s international image and attracting highly qualified personnel to support the growth of the Bulgarian economy. It has already announced a number of measures corresponding to European and national strategic documents, such as the National Development Programme 2030, the Innovation Strategy for Smart Specialisation, the National Strategy for Promotion of Small and Medium Enterprises and others to increase growth potential.

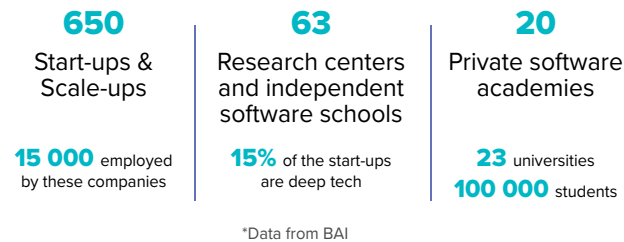
By the end of the year, the Ministry of Innovation and Growth will provide BGN 735 mln in grants to small and medium-sized companies, of which BGN 600 mln will come from the National Recovery and Resilience Plan (NRRP).

## Invest Bulgaria Agency

Website: [www.investbulgaria-virtualoffice.com](http://www.investbulgaria-virtualoffice.com)

Invest Bulgaria agency is a government organisation under the Ministry of Innovation and Growth. Its main purpose is to help potential and existing investors explore investment opportunities in Bulgaria and carry out greenfield investment projects in the country.

## RESEARCH & DEVELOPMENT



## Invest Sofia (Sofia Investment Agency)

Invest Sofia supports the capital in creating, attracting, retaining and inspiring talented professionals – entrepreneurs and researchers – that will help turn the city into a centre of innovation for high value-added industries. The agency's main priority is bridging business and academia, reflecting in improved planning and availability of skilled and professional human capital. Sofia has a specially developed Methodology for Assessment of Projects in the field of digitalization and innovative urban solutions. This is a result of the agreement for a grant of consultancy support signed a year ago between the Sofia Investment Agency and the European Investment Bank.

Sofia Investment Agency will also support the activities of Borderless AI – an international project launched in 2020 at the initiative of AI Cluster Bulgaria and AI Austria. The mission of Borderless AI is to connect organisations and companies in the field with academia, regulatory experts and policy makers and help them exchange information on current critical issues and challenges in front of the European and international AI community. Partners since the start of the project are also Health & Life Sciences cluster Bulgaria, AI Serbia, AI Sweden and partners from the UK.

Sofia remains the area with the highest educational attainment levels in Bulgaria. It has the most favourable demographic structure and is among the few regions that continue to attract people showing a positive mechanical population growth rate of 2.4%.

Alternative ICT education is growing in popularity.

Over 30 private academies offer short- to mid-term educational programmes (six to thirty months). Subjects range from software development and 3D design to IT project management taught by leading IT professionals. Companies developing AI technologies are strengthening their collaboration with universities to find the specialists they need.

Sofia Invest Agency (SIA) offers end-to-end investment services, tailored according to specific needs. The services cover every stage of setting up an AI business in Sofia, ranging from initial data collection and opportunity/benchmark analysis to networking and the actual business launch.

## Innovative Sofia

The Digitalisation, Innovation and Economic Development department of the Sofia Municipality, known as Innovative Sofia was established in 2020 to support the development of Sofia as a digital, innovative, intelligent and technological city.

The goal of Innovative Sofia is to be the main driver for the digital transformation of Sofia – to initiate and coordinate policies and to consolidate and guide the city's digital and smart city projects; to facilitate the development of the high-tech and R&D sectors and the establishment of international partnerships; to support the development of Sofia as a recognizable brand and the local ecosystem as a digital and innovative hub.

**The Digital Transformation Strategy for Sofia** was developed under the Digital Cities Challenge (DCC) project of the European Commission by Innovative Sofia together with EU experts and over 100 local stakeholders. The strategy aims to encourage the development of innovative solutions for the digital transformation of the city and to support the innovation system – including, of course, the ever-growing AI sector – in enabling the development and absorption of new digital services and smart solutions. In 2020, the Strategy and the Action Plan for its implementation were unanimously approved by the Sofia City Council.

## Work on Digital and Innovative Projects

- Innovative Sofia's **Sandbox for Innovative Solutions** aims to identify scalable pilot projects and test innovative technological solutions related to various urban challenges on topics such as e-government, entrepreneurship, innovation, environment, education, and transport. The projects are being evaluated via an approved methodology developed by Deloitte in a joint project with the EIB. They are to be implemented in a short time - with a quick test and low financial risk.

- Sofia Municipality is a co-founder of the European Digital Innovation Hub (EDIH) for big data, high-speed computing and artificial intelligence, created at the end of 2020 to increase the competitiveness and business potential of SMEs, industry and society in the Southwest region of Bulgaria by supporting the digital transformation and integration of the existing infrastructure, know-how, technologies and expertise in the field.
- Sofia Municipality is working together with the GATE Institute on the creation of the first digital twin city of Sofia to be developed on the territory of the Lozenets district and validated in three pilot scenarios in the fields of urban planning, air quality, and public transport.
- Since the beginning of the pandemic, Skilly the Bot has answered 15,000+ citizens' inquiries related to the COVID-19 situation in Sofia and Bulgaria, providing them with the latest official information and data. Skilly is AI-based and continuously improves its skills and knowledge. It was developed by the Sofia-based Abilitics and provided for free to the City to support the fight against COVID-19.

### Participation in International Initiatives

Innovative Sofia, on behalf of Sofia Municipality, is currently coordinating the participation of the city in several international innovation and digital transformation programmes:

- Intelligent Cities Challenge (ICC) – the follow-up project to the Digital Cities Challenge programme of the European Commission involving 136 cities. Under the project, Sofia is receiving personalised expert consulting support to develop a concrete project, instrument or process together with the local system to further foster and facilitate the city's development in the area of e-government and citizen participation.
- PolicyCLOUD – a 3-year-long project of the European Commission under Horizon 2020, aiming to create cloud-based tools for effective policy modelling, testing and management through data analysis and visualization. Being part of the project, the City of Sofia will be able to perform simulations, tests and analyses of potential initiatives and policies by using different categories and types of data.
- Bloomberg Philanthropies' Digital Innovation Initiative 2020-2022 – an international programme on urban digital transformation management with participants from 21 European cities. Under the Initiative, Sofia receives consultancy and technical support for the optimisation and redesign

of municipal administrative services in order to improve residents' awareness of, access to and overall experience of using them.

- Regional and Local Data-Driven Innovation Through Collective Intelligence and Sandboxing – an 18-month project with 12 participating cities, run by the European Commission's Joint Research Centre (JRC), focused on the development of policies for sandboxing and innovative solutions and knowledge exchange to facilitate local ecosystem participation in creating urban solutions, as well as experimenting with new approaches to leverage on the potential of data and data-driven innovations for urban development.

### Fund of Funds (FoF)

Fund Manager of Financial Instruments in Bulgaria EAD (FMFIB) operates as a Fund of Funds (FoF); it allocates targeted public funds from European Union programmes and national co-financing, using special financing schemes (financial instruments). The mission of the FMFIB is to ensure efficient use of EU financial resources and to provide enhanced access to financial resources for the private and public sectors in Bulgaria by applying innovative and flexible forms of financing; to support business competitiveness and sustainability, assist projects with growth potential and provide opportunities for the development of innovative business ideas to create a more favourable business environment, promote employment and economic development in Bulgaria, improving the quality of life in towns and regions.

The Fund of Funds supports the Bulgarian business sector, including innovative tech companies, with a total of EUR 142.8 mln, allocated to intermediary investment funds. FoF's intermediaries (fund managers) offer equity and quasi-equity investment and operate across the whole company development cycle. Innovation Capital, Vitosha Venture Partners and NV 3 manage resources under the Seed/ Acceleration and Start-up Funds, Morningside Hill – under the Venture Capital Fund and in 2021 an agreement was signed with Silverline Partners to implement the Mezzanine/ Growth Fund.

### Financial Instruments Programming Period 2021-2027

- For the 2021-2027 Programming period FMFIB is planned to manage EUR 1.25 bln, thus increasing the areas for impact
- Possibility of financial instruments and grants combined with FI in one single operation (with rules applicable to the FI)

## HOLDING FUND



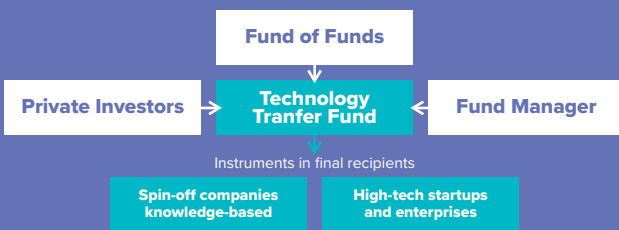
### Technology Transfer Fund

Budget: EUR 60 mln

Type: Equity and quasi-equity investments fund

Average size of the investment: EUR 2 mln

- Support for creation and development of enterprises in Bulgaria, cooperating with other enterprises, universities and/or research organizations, with the aim of deploying research and innovation;
- Technology transfer and commercialization, for the transformation of scientific developments into marketable products and technologies;
- Stimulating the process acceleration of early stage spin-off and start-up companies around mature industries and clusters, in order to share the benefits of research and innovation in a highly efficient way.



### AI Success Case

In March 2021, NV3 announced EUR 150 000 investment in MYX, a company working in the digital twins field. MYX developed a platform that generates highly accurate digital representations of physical assets, overlaying them with AI-powered analytics. Total funding in the round is EUR 350 000. The major part of NV3's ticket is secured by the Fund of Funds. MYX will utilize the funding to accelerate product development, expand its team and for local and international business development activities.

### SOFIA TECH PARK JSC (STP)

SOFIA TECH PARK JSC (STP) (<https://sofiatech.bg/>) is the first science and technology park in Bulgaria, created with the aim to be established as a platform for exchange of knowledge and ideas between the academic field, the business, the government and the society. Its mission is to turn into a prestigious location for the world, regional and national researchers and innovative companies in Bulgaria and through the Balkans. The infrastructure of the park includes:

- Incubator for innovative start-ups companies offers co-working open spaces for start-ups and SMEs where they can share knowledge, build peer-to-peer managerial and scientific capacity and develop their products and solutions;
- Innovation Forum hosting thematic events;
- Laboratory complex for research and development;
- TechnoMagicLand to spark the interest in technology and sciences in children.

The Laboratory complex is one of the key elements of the park, consisting of 11 laboratories and managed by an independent Research and Development and Innovation Consortium. The laboratories provide opportunities to the academic field and the business to develop their own scientific projects, as well as the development of products and services with the help of the laboratory teams, so that they can successfully reach the market.

### AI at Sofia Tech Park

The Artificial Intelligence and CAD Systems Laboratory is playing a key role in Sofia Tech Park's mission by providing a place/space where opportunities, coming from different industry verticals, meet knowledge and resources to make the innovation happen.

Research and development in the following areas: intelligent systems for medical applications, robot and drone control algorithms, intelligent systems for early warning of natural disasters and intelligent systems for recognition and certification of materials and products, such as:

- Development of a robot for UVC disinfection.
- Development of an expert system with artificial intelligence for automated diagnosis of diseases based on image diagnostics. The system is trained to be able to recognize and assess whether a patient has had COVID 19 based on X-rays as input.
- Use of CAD systems in the field of microelectronics, telecommunications and intelligent transportation; design and modelling of new devices, systems and technologies, as well as design and modelling of sea vessels.

## Zoom on Investment Ecosystem:

**The European Investment Fund (EIF)** operates actively in the Bulgarian market via investment directly in start-ups (49% of 90+ start-ups directly backed by EIF) and also directly into venture funds such as Launchub Ventures; NEVEQ; Sofia Angel Ventures, as well as the Bulgarian Fund of Funds which is a main vehicle supporting other VC funds, such as Eleven and Vitosha Venture Partners, to name a few.

Since 2013 Bulgarian venture capitalists have invested over EUR 85 mln in 255 funding rounds, data from Dealroom shows. Our latest calculations based on data by the Bulgarian Venture Capital and Private Equity Association (BVCA) and own sources show that only between 2015 and 2018 EUR 64.5 mln have been invested. This, however, includes predominantly the activity of funds backed by the European Investment Fund, and only a small amount of the private capital.

Based on Dealroom's data, Bulgaria lands among the top three hubs by the number of rounds in CEE, right after Poland and Estonia. Just like here, the VC is concentrated in the capital cities across the whole region. Based on the amount of money put into tech ventures, Bulgaria ranks ninth among 16 countries in the region.

Despite the large estimated number, however, the median size of the investments in Bulgaria, but also in the whole CEE region is still low compared to the rest of Europe. The average size of a seed round in Bulgaria is EUR 400 000, which ranks the ecosystem 21 among 23 ecosystems evaluated by the platform.

### Overview of Bulgarian VC funding landscape

Despite the pandemic triggered by COVID-19, it seems that Bulgaria experienced thriving growth. Country indicates the total number of 59 transactions that took place in 2020. Bulgaria's statistics include the business angels' activity. Hence, for 2020 BVCA reports 56 investments by venture capital and private equity funds and additional 3 deals by business angels. The number of deals, the investment numbers in terms of value come close for 2020, with the total volume of investments in Bulgaria at EUR 29.4 mln.

#### BVCA

Website: [www.bvca.bg/en](http://www.bvca.bg/en)

BVCA unites the investment community in Bulgaria and creates a strong public platform for each member to make positive impact on the industry. The association works closely with all interested parties to ensure sound public policy, which fosters entrepreneurship, innovation and growth.

#### CEO Angel Club

Website: [www.ceoangels.bg](http://www.ceoangels.bg)

CEO Angels Club is a group of senior executives and entrepreneurs related to Bulgaria investing their own money in early stage startups in return for equity.

Our members make their own investment decisions and they can invest together or individually. They also provide expertise, contacts and pro-active mentorship to increase company value.

CEO Angels Club looks for early stage, normally post-accelerator startups that are highly scalable and that can show us how the company will get to break-even or to a clear meaningful mile stone (e.g. Seed or Series A. Funding) within 12-24 months on the basis of our one-time investment. This typically means smallish teams (2 to 5 people), with serious domain expertise and a product that is either currently in the market or already in beta.



## Bulgaria's IICT institute co-operates with private, public organisations to cover full NLP range in Bulgarian language

The Institute of Information and Communication Technologies (IICT) conducts fundamental and applied research in the field of computer science, information and communication technologies (ICT) and in the development of innovative interdisciplinary applications of these technologies.



Professor Galia Angelova is Director of the Institute.

**Prof. Angelova, one the main fields of operation of the Institute is natural language processing. Many private companies also have projects in that field. Do you co-operate with them or is the Institute developing its own projects?**

Natural Language Processing (NLP) is one of the pillars of AI. We have been extensively working on the creation of integrated language resources that would include lexical data, corpora and world knowledge, i.e lexicons, wordnets, ontologies, knowledge graphs, treebanks as well as general or domain-specific annotated corpora. On top of these resources, we have been also developing language processing pipelines that cover tasks from tokenisation to word sense disambiguation, language models and others. These basic processing modules are used in a wide range of applications including machine translation, creation of domain oriented knowledge processing pipelines, semantic document indexing, knowledge extraction, question answering, multi-document summarisation, keyword extraction, smart education and others. As more advanced applications we list speech processing, intelligent support in eHealth via information extraction from patient documents, machine translation for legal documents including semantic processing, abstractive summarization based on neural language models and construction of a Bulgaria-centric knowledge graph. In 2022, IICT developed and delivered to the Bulgarian Union of the Blind a speech synthesizer using a unique neural network model which automatically puts the word stress to ensure naturally sounding synthesized speech in Bulgarian.

IICT works mainly for Bulgarian language but it also supports the multilingual NLP via integration of Bulgarian language resources with resources for other languages like the Open Multilingual Wordnet, the Universal Dependency Initiative and the ParlaMint Project. The technologies developed within the institute are language independent and can be adapted to other languages given the availability of the corresponding training resources.

IICT often co-operates with companies and public organisations. We work together with Sirma AI (Ontotext) on

tasks related to semantic processing of Bulgarian texts. Our NLP team provided to APIS Bulgarian language resources and technologies for semantic indexing, keyword extraction, extraction-based summarization and machine translation for legal documents. We work with Identrics on training of bias neutral neural language models for Bulgarian, classification of texts with respect to potential fake news content and development of models for abstractive summarization. IICT has developed a highly efficient system for indexing and recognition of advertisements in TV streams for the Bulgarian company H-Tech. In 2015, we participated in the development of the National Diabetes Register which was automatically generated from pseudonymised outpatient records submitted to the Bulgarian Health Insurance Fund. Important indicators like values of blood sugar and glycated haemoglobin levels, body mass index, blood pressure etc. were automatically extracted from unstructured text and integrated into the database. Today the Register is hosted and updated by the University Specialised Hospital for Active Treatment of Endocrinology at Medical University Sofia.

**IICT is also using AI in relation to the EU's Green Deal and the implementation of its objectives in Bulgaria. How can AI facilitate this process and in what areas is Bulgaria looking to use AI?**

AI enables the analysis of Big Data thus increasing our capacity to better understand, monitor, analyse, control, predict and tackle the environmental challenges as well as the performance of industrial systems that have to adapt to sustainable behaviour. It seems that monitoring and optimization of energy consumption is substantial for Bulgaria as well as the integration of renewable energy sources, and AI can help in this respect. Another important area is agriculture where AI provides tools for more efficient use of land, water, pesticides and fertilisers which could mitigate environmental impacts (agricultural applications of AI are significant anyway, to improve efficiency and farming practices).

**What projects does IICT have in the pipeline?**

IICT performs numerous projects in areas bordering with AI like decision-making, optimisation and intelligent control so I will mention here only a few examples of our activity. We coordinate CLaDA-BG, the Bulgarian national interdisciplinary research e-Infrastructure for Bulgarian language and cultural heritage, part of the EU infrastructures CLARIN and DARIAH. CLaDA-BG is funded by the Ministry of Education and Science and develops a Bulgaria-centric knowledge graph and AI tools for processing big data, old varieties of Bulgarian, 3D images and other related information.

IICT participates in the Horizon Europe Pathfinder project NEMO BMI (2022-2025) which aims to achieve the first assistance-free neuroprosthetics system. The project addresses the restrictions of current neuroprosthetics devices that require regular retraining within controlled environment by development of an auto-adaptive brain-machine interface which translates motor cortex signals into commands to external effectors. Researchers from this team are elaborating a realistic brain model for HPC simulation of human visual system and conscious perception, within a project funded by the Bulgarian National Science Fund.

The starting project SynGRDiT (Synergy for Green Regional Digital Transformation), which will establish the European Digital Innovation Hub Zagore, is another challenging task.

# Major AI technologies adopted in Bulgaria in recent years

## Efemarai

Efemarai is a platform for testing and debugging ML models & data. They bring SQA principles to robustify ML and enable continuous integration and debugging flows in the \$150b applied AI market, currently dominated by inadequate homebrew debugging tools. Efemarai's solution is twofold:

- ☛ Testing pipeline - easily define specs and run tests to discover novel failure cases before reaching production and build trustworthy ML systems.
- ☛ Visualization engine - actually see what causes a test to fail and understand why by exploring intuitive 3D visualizations of the underlying data and models.

With Efemarai, ML engineers can not only discover novel failure cases before reaching production and gain trust in their solutions, but also boost reliability & performance of ML models as well as significantly reduce the time for developing & debugging ML code.

Efemarai is led by Svet Penkov, CEO, and Daniel Angelov, CTO. Both have PhD in AI and Robotics and have spent countless hours of ML testing and debugging both in academia and industry.

**Want to know more?**  
<https://efemarai.com>

## AI4D

AI4D offers a revolutionary approach to drug discovery. The platform employs Artificial Intelligence (AI) which is guided by a model of human creativity in the identification of 'secret gem' in molecules. We are able to pinpoint promising candidates from millions of entities, reduce the discovery phase to 8 weeks, and release a new drug for treatment in 30 months. We believe that we need more than ever greater efficiency in discovering therapies to tackle global disease challenges and populations needs.

Drug discovery technologies market is expected to reach \$86 bln by 2022. We are targeting a 3% share of the global market of In Silico Drug Discovery which will generate us \$240m annually only from the delivery of services by 2029.

AI4D is led by Ivan Stankov (CEO), Evgeni Marinov (CTO), Dimitar Dimitrov (Chief Strategy Officer), Filip Fratev (Chief Scientific Officer).

## Micar21

Drug Discovery For Novel Small Molecules

Micar Innovation (Micar21) is an in silico drug discovery company offering a suite of disruptive technologies and a fully integrated spectrum of expertise to advance innovative medicines for the treatment of diseases with unmet medical needs. The company has direct access to cutting edge drug discovery technology based on improved structure-based in silico drug design from scratch through to the stage of Pre-clinical phase with advanced target-specific predictions of absorption, distributions, metabolism, excretion, and toxicity (ADMET). Micar Innovation (Micar21) is actively developing promising first-in-class and best-in-class therapies to treat unmet and genetic diseases. The company pipeline consists of 18 first-in-class small molecules in 7 therapeutics areas.

Usually the Drug Discovery process takes between 1-2 years. Micar Innovation (Micar21) Drug Discovery process from Scratch until Preclinical study takes only 2-8 weeks, by implantation of sufficient AI solutions (In silico) in traditional scientific approach. The company improved Schrodinger's FEP+ by 40-50% and shorted lead optimization to only a few weeks, greatly reducing the overall cost of the R&D.

Micar Innovation (Micar21) has a number of publications in high impact scientific journals, such as Nature, ACS Med. Chem, Journal of Biomolecular, Structure, and Dynamics, Journal of Chemical information and modeling and won recognition and acknowledgement for its innovation capacity, in 2018 it was awarded

in the start-up category of the ‘Innovative Enterprise of the Year’ national contest, held under the auspices of the President of the Republic of Bulgaria. Among the other awards, the Micar 21 team won Investor of the Year for 2018, awarded by the Bulgarian Agency of Investment and Ministry of Economy, Innovative Enterprise of the Year by the European Centre for Economic Diplomacy Grand Prize - CIDIC, Best Biotechnology Start-up for 2017 at the Central and Eastern European Startup Awards, etc. The company is a co-founder of Health & Life Science Cluster Bulgaria. The report of AI Venture Labs states that Micar Innovation (Micar21.com) is one of the 8 companies in the world using artificial intelligence, which has developed in the field of discovery of new drug molecules in the fight against COVID-19.

Micar Innovation (Micar21) has development a flexible and commercially viable business model which is comprised of three primary focus areas:

- ❖ Pharma Collaborations – supporting small molecule drug discovery by working with the pharmaceutical industry.
- ❖ Contract Research Organisations Co-development – addressing the small molecule discovery needs by co-development with CROs.
- ❖ Proprietary Pipeline Development and Spinoff – building a proprietary pipeline of novel first in class candidates for pre-clinical and Phase I clinical studies.

Micar Innovation (Micar21) has a special Drug Discovery De-Risking Model for investors and collaborators.

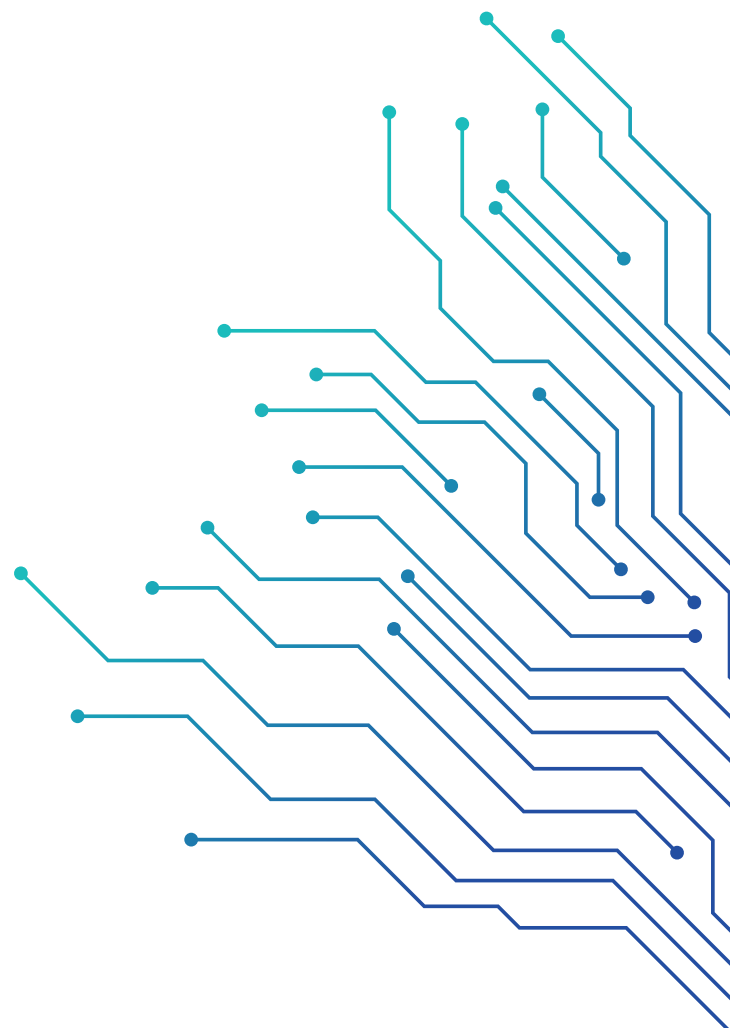
Micar Innovation (Micar21) has a strong track record in the development of drug molecules that bind to the so-called chemokine receptors, in particular CCR2, CCR3, CCR5, CCR6, CCR7, and CCR9 receptors.

The company has a strong record of research in the field of COVID-19. In December 2020, the head scientist of the company announced the result of calculation over the new mutations of the virus and possible human immune response and the success of existing vaccines. At the end of February 2021 the prediction was validated in an article at Cell Journal.

## Telelink Business Services EAD (“TBS”) & Sofia University “St. Kliment Ohridski” (“SU”)

TBS and SU are the driving force organisations in the INNOAIR project - the first Bulgarian AI project funded by the EU initiative Urban Innovative Actions, which enables large European cities to test innovative, creative, but also risky solutions to urban challenges. INNOAIR experimentally implements measures in the thematic area of “air quality”, in particular “innovative green mobility solutions” in order to reduce air pollution generated out of traffic conjunctions in urban environments.

The project is in its initial phase and will test in a real environment for the very first time in Europe the concept of On-demand public transport. The aim of the project is to provide citizens with green on-demand travel alternatives, reduce car traffic and improve air quality with the support of its AI based software.



# Trends and challenges

***Based on a survey conducted by AI Cluster and SeeNews between April and August 2022. The survey encompasses 15 companies with core activity related to developing AI solutions and reveals the key trends and expectations of the players in the Bulgarian AI ecosystem.***

The AI industry in Bulgaria is undoubtedly making great strides. Still, like any other young branch of the economy, it is faced with challenges. Our survey was aimed at identifying those as well as the trends currently dominating the landscape.

Most of the players in the ecosystem consider Bulgaria to be a location with great potential to become an established international hub for the development of AI solutions. More than two-thirds of the respondents believe this can be achieved but a number of conditions need to be met. The most important prerequisite is active government support through well-developed AI and IoT strategies; legislation that targets specifically AI development; improvement of the infrastructure; facilitating investments; enhancing data availability; support of deep tech startups; stimulating collaboration with academic institutions and investment in high-quality education in state universities. Another key area that currently poses somewhat of a challenge is the need to foster international relations with countries that lead the global progress in terms of AI. A third concern is the availability and quality of talent – the respondents in our survey have identified an acute need for the ecosystem to focus on improving and further developing specialised skills and capabilities in the AI area in addition to the already solid programming skills of the labour pool. Another issue in the area of talent is the current legal process for attracting talent from abroad, especially Ukraine and Moldova, but also from Russia and Belarus.

There are also pessimistic opinions – about 15% of the respondents say there is no chance for Bulgaria to become an international AI hub, given the gap between its current phase of development and the top global AI destinations.

Beside the AI ecosystem, individual companies in Bulgaria are also faced with multiple challenges when it comes to creating or adopting AI solutions. To a large extent, they are similar or derive from the challenges for the whole ecosystem, such as the need for functioning legislation and the scarcity of highly-skilled labour force in specific areas, such as

machine learning. Furthermore, most respondents agree that the early stage of AI awareness and adoption as well as the heterogeneous data input and the heavy initial investments to acquire data are major obstacles.

With regard to the future development of the sector in terms of possible spin-offs, respondents demonstrated a complete parity. Half of the entities plan to spin off part of their activity related to AI in the short to medium term and the rest do not envisage such a step yet. No connection can be determined between the spin-off readiness of the companies and their size or the sectors they provide services for. Rather, spin-off plans are highly individual and are impacted by the stage of the life cycle in which each company is currently in. One of the companies is already set up as a result of a spin-off from a large software vendor.

In terms of industries served, the IT sector is undisputedly the most important client of Bulgarian AI solution providers, being served by 40% of the survey participants. Banking and financial comes second with 27% of the respondents providing solutions to it. Manufacturing, healthcare, transportation, logistics, business processes and customer support are the other industries singled out in the survey as major clients of the AI vendors.

As for specialisation in a narrower sub-field of AI, Bulgarian companies are mostly active in machine learning. Nearly half of the respondents, or 47%, say their organisation has the expertise to develop its own algorithms in this area. The clients of companies specialised in machine learning are scattered across the industry verticals, mainly in IT, but also in manufacturing, healthcare, banking, transportation and logistics. The second most popular technological sub-field, in which Bulgarian AI vendors are active, is natural language processing with 20% of the responses, followed by neural networks with 13% and cognitive computing, deep learning and semantic robotics.

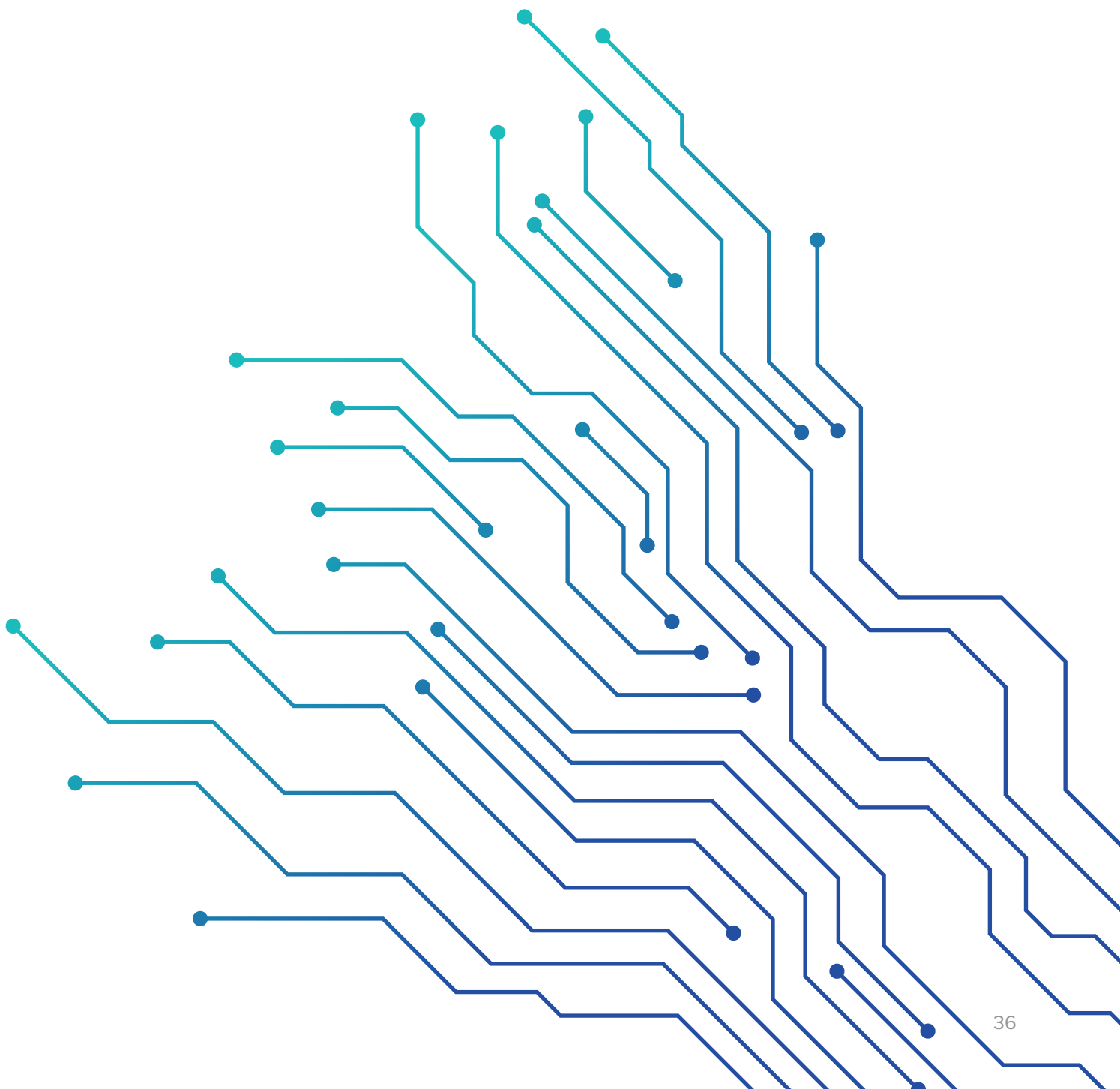
Bulgaria's AI ecosystem is open to cooperation with educational institutions in order to tackle the insufficient availability of highly skilled talent. More than half of the respondents have already established or plan to enter into partnerships or work with universities on their projects. Among the most often mentioned AI-related expertise missing on the local labour market are algorithmic deep learning, PhD research scientists,

senior-level machine learning engineers, programmers with deep knowledge of maths and statistics, stochastic optimisation expertise, as well as lack of hands-on experience with solving AI problems of the potential talent pool.

Unsurprisingly, most companies prefer to recruit through their own network – half of the respondents say this is their preferred method to find talent. Job boards also play a significant role and are the major channel for hiring specialists for 20% of the respondents. Internal promotion is the third most widely used employment method, while other options, such as references and contacts with universities still have a complimentary function to the above-mentioned sources.

Public infrastructure seems to be a key asset for the Bulgarian AI industry. While its improvement was already mentioned as one of the key challenges, such infrastructure providing high-performance computing, secure data collection, storage and processing and 5G connectivity is already used by more than 60% of the respondents and expectations are that this share will grow.

The same share of the companies participating in the survey – 60%, have used internal investments for their first AI project. One in five vendors has received financing through venture or private equity rounds and only one company was supported by financing from its customers. About 20% of the respondents still have not launched their first AI project.



# Ethics of AI: A Bulgarian Perspective

The ethical dimension of AI-related innovation plays a major role in the social acceptance of IT systems leveraging the capabilities of both knowledge-based and data-based AI. In the EU, the adoption of the Ethics Guidelines for Trustworthy AI by the High-Level Expert Group on AI in 2019 was without a doubt a major achievement in that it provided a three-component analytical framework for socio-technical assessment of AI throughout a system's life cycle. That trustworthy AI should be lawful, ethical, and robust is now commonly understood in the EU. Particularly, the ethical requirements of trustworthy AI demand that a system should be aligned with certain ethical principles and values.

While European trustworthy AI is undoubtedly based on these values, it is naive to believe that socio-cultural differences between the Member States are not going to play a role in how AI is being developed and deployed across the EU. The particularities of the Bulgarian historical and socio-cultural context hint that certain challenges might be more pronounced here and may need to be targeted specifically by the local business, industry and non-governmental communities.

In the context of Bulgaria, there are several country-specific ethical issues concerning AI that require collaborative solutions.

The first one is the question of how AI technologies deployed for the generation of fake news may interfere with the freedom of expression and its counterpart right to impart information. Amidst the global pandemic caused by COVID-19, we have witnessed how widely spread fake news and other manipulative techniques, in many cases reinforced by AI, are capable of exerting decisive influence over an individual's personal beliefs. Anti-vaccine campaigns, conspirative theories about the origins of SARS-CoV-2 or false figures concerning the number of casualties of the pandemic have undermined societal trust in institutions. The Bulgarian society is increasingly vulnerable to manipulation as a result of sophisticated AI-driven technologies which continuously serve users on popular platforms with manipulative and deceitful content capable of interfering with their personal autonomy.

A spill-over effect of this ethical issue can be seen in many other areas of social life. Such harmful

practices can interfere not only with the freedom of expression and the right to impart information but may also result in discriminatory practices against vulnerable groups. Furthermore, impulsive decision-making driven by fake media reports can result in interference with an individual's right to healthcare. Reports from around the world showed dramatic footage of people on their deathbeds refusing to believe they are dying as a result of COVID-19. Others have chosen not to seek medical help in the belief that COVID-19 is not a serious disease. The Bulgarian AI community should therefore seek ways to mitigate these adverse impacts by creating solutions for detection of sources of fake news and leveraging the actual capabilities of AI to fight this harmful phenomenon.

A second issue concerns recruitment practices which are expected to increasingly rely on AI-driven technologies for pre-screening of candidates' eligibility. Article 22 of the General Data Protection Regulation gives individuals the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning them or similarly significantly affects them, but for many people this would mean little in practice. Jobseekers in many sectors of the economy lack the appropriate background knowledge to even be aware of the fact that their application might have been subjected to automated decision-making. Even in the cases where they do know, exercising this right might be difficult from a practical point of view, simply because many of the recruiters might not even know themselves why a particular decision was taken. This creates a lot of moral issues concerning not only individuals' human dignity but also the potential for unlawful discrimination. The AI research community and industry should work together to create solutions that are tailored to the specifics of the Bulgarian labour market, the general awareness of one's employment rights and that facilitate individuals' right to have human intervention in the decision-making process in a meaningful way.

Discrimination presents a third set of horizontal issues that may extend across many different domains. Well-known issues with discrimination against minorities and other vulnerable groups in the Bulgarian society may be reinforced through the deployment of AI solutions which may rely on local, yet biased data sets. Indeed, the widespread

issues with discrimination and social exclusion can only be mitigated by adopting local practices for data collection and curation that are based on the principles of equality, diversity, and social inclusion. In other words, AI solutions should be trained and tested with data sets that contain rich data points representative of the characteristics and needs of the affected populations.

Another issue concerns the problem with interpretability and explainability of AI decision-making. While this aspect is connected to the second and the third issues on harmful recruitment practices and discrimination, it is also a distinct issue in and of itself. Because of said geopolitical, historical, and socio-cultural particularities, explanations of AI-driven decision-making created in a Western European, American, or Chinese context are unlikely to have the intended positive impact in an Eastern European, and, more specifically, Bulgarian context. Culturally sensitive explanations may be needed in certain critical sectors where AI is expected to be deployed on a large scale. This would require investment in socio-technical and sociological studies in order to determine the expected standard of explanation of a particular decision in a specific context that meets the needs and capacities of affected individuals.

Last but not least, access to and sharing of data among the different priority sectors for AI deployment – manufacturing, healthcare and agriculture, is a notable challenge that may require establishing new collaborative relationships between unusual partners. Further work is needed to pinpoint the incentives for data sharing that accounts for the specifics of the Bulgarian AI market. The role of SMEs and NGOs in this direction would be of critical importance. Along with the analysis of the incentives, there is also a need to consider the problematic uses of data science as part of the broader issue of data ethics. The development of data ethics frameworks built upon the principles of accountability, fairness and transparency is a task for both the research community and the industry. Data ethics frameworks need to reflect the socio-cultural specifics of the Bulgarian society, while accounting for the general business climate in the country and the most promising use-cases for the deployment of AI.

# Events

## Women in AI

9 November 2022

Online

Women in AI is about the most recent technological developments as well as practical examples of how to apply AI trends and innovations to business and societal concerns. The unique combination of academia and industry allows you to interact with AI pioneers at the cutting edge of research while also investigating real-world case studies to learn about the business benefit of AI.

## European AI Forum

December 2022

The European AI Forum is an initiative launched in June 2020 on the final day of the Croatian Presidency over the Council of the European Union.

Initially planned as a conference that takes place towards the completion of each Council Presidency, the European AI Forum has turned into a network of associations that want to make sure startups and innovators in Member States have a voice when it comes to building an AI regulatory framework.

Founded by CroAI, Hub France IA and KI Bundesverband, our Community has grown to include AI4SI, AI Austria, AI Cluster Bulgaria, NL AI Coalitie and AI Poland.

**Website:** <https://www.european-ai-forum.com/>

## ACM/IEEE International Conference on Human-Robot Interaction

March 13 - 16, 2023

Stockholm, Sweden

The conference theme for HRI 2023 is “HRI for all” and will focus on key HRI theories, methods, designs, studies, and technical advances that aim to understand and promote inclusion and diversity in HRI. We encourage the community to consider ways to both make the field a more inclusive place for those who may not feel included, as well as to encourage inclusion within our research methods and practices.

## Rise of AI Conference

May 10, 2023,

Berlin, Germany

The Rise of AI Conference, held in Berlin, has six years under its belt and has got a spot in this list of top AI events. The main focus here is to create a robust European AI ecosystem for the greater good. Every year, over 2,000 policymakers, researchers, entrepreneurs, business executives, and investors convene at Rise of AI to explore, control, and deploy the trends and applications of artificial intelligence.

**Website:** <https://riseof.ai/>

## TNW Conference

15-16.06.2023,

Amsterdam, The Netherlands

Join the TNW Conference and learn from industry experts who will talk about applications and innovations in Artificial Intelligence. There's something for everyone, from growing your business and increasing your ROI to contending problems and overall knowledge. You will meet international tech executives, politicians, startups, scale-ups, and general tech lovers.

**Website:** <https://thenextweb.com/conference>

## Spinoff Bulgaria

22-23.06.2023

Bulgaria

The Spinoff Bulgaria initiative was created by the Health and Life Sciences Cluster Bulgaria, the Artificial Intelligence Cluster Bulgaria and Venrize.

The 2022 conference is supported by the Bulgarian Small and Medium Enterprises Promotion Agency (BSMEPA) as a general partner and co-organizer.

The goal is to create a sustainable spin-off ecosystem and culture in Bulgaria and Europe by connecting national stakeholders with international partners. We will present best practices and insights from universities, investors, governments, corporates and relevant industry experts, as well as funding opportunities from European organizations.

**Website :** [www.spinoff.bg](http://www.spinoff.bg)

## Data Science Week 2023: World Conference on Data Science & Statistics

June 26 to 28, 2023,

Frankfurt, Germany

World Conference on Data Science & Statistics (Data Science Week 2023) slated in Frankfurt from 26th to 28th June, 2023 with the theme “Understanding the Data Science: Can help now and in the Future”.

## GITEX Technology Week

October 2023,

Dubai, United Arab Emirates

This is one of the world's largest AI events for technology and industry. Gitex Technology Week, held in Dubai, brings you six shows with over 4000 exhibitors and over 1000 expert speakers. It's a massive event that will bring together the tech world and showcase the latest in innovation.

**Website:** <https://gitex.com/>

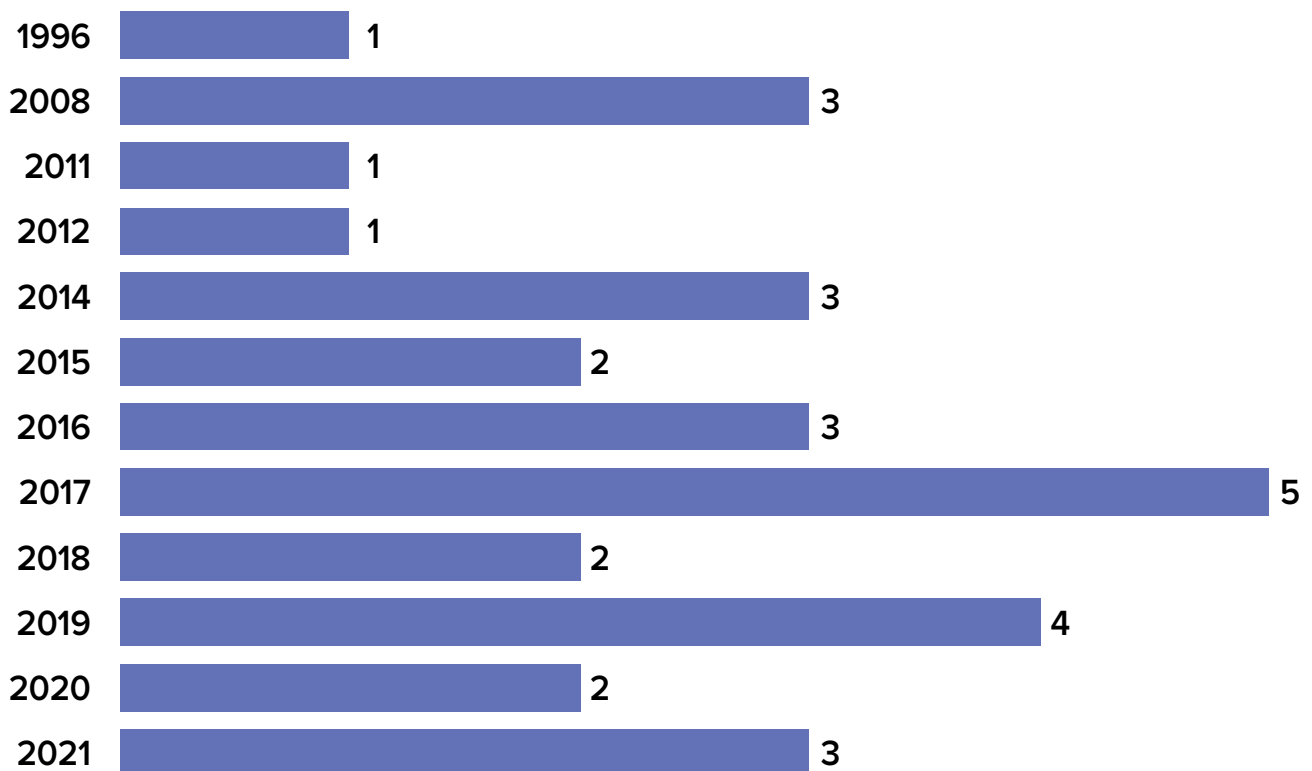
# Vendors Landscape

## Number of companies by year of establishment

The period between 2016 and 2021 saw the emergence of the bulk of the companies focused on AI development in Bulgaria. The first major wave was between 2016 and 2018 when ten of the sector players were established. The trend continued further in the 2019-2021 period when

nine further companies entered the market. The wider use of AI technologies and solutions, along with the blooming local AI ecosystem are expected to boost the next wave of AI developers in the next three years.

**Fig. 1** Number of companies by year of establishment



## Semantic technology helps manage any industry's complex knowledge

***Ontotext is a software company with offices in Europe and USA. The company was first launched in 2000 as an R&D lab within Sirma group. Today, Ontotext is predominantly focused on software solutions based on proprietary semantic graph databases and text analysis pipelines. Those solutions bring data and content together in big knowledge graphs to allow better interpreting, analyzing and reuse in numerous verticals. Earlier in 2022, the company was acquired by a consortium led by investment firm Integral Venture Partners. The capital will help Ontotext accelerate its international expansion and go-to-market operations, focusing on the US market. This interview is with Atanas Kiryakov - founder and CEO of Ontotext.***



***Mr. Kiryakov, semantic technology has been increasingly on the rise in popularity in recent years. Have the sectors where it is most commonly used changed, or is the list still the same as it was four or five years ago?***

A lot has changed. I will give you an example of enterprises from the life sciences and healthcare verticals. They have always been a strong user of this technology, although actual demand was different five years ago, based on the phase of the market. Those companies have always wanted to use this technology but only sometimes had the money to invest. So five years ago, significant demand came from pharma, life sciences and publishing media. The financial services sector was also interested but needed to implement projects faster and make real solutions.

The entire use case for graph technology and semantic technology for managing complex technical knowledge, whether it's different car components or all sorts of devices in a big building, wasn't around five years ago. The most important new sectors that weren't there five years ago and are now becoming significant consumers of these technologies are manufacturing, aerospace, defense, infrastructure management and energy. Think of customers like NASA, the most prominent automotive vendors, and infrastructure management companies. One of our clients is Johnson Controls, which focuses on building automation. In

fact, two of the biggest providers of building automation and building management systems use our technology to manage the configuration of all devices.

I also mentioned energy - there are very high standards across Europe on how everyone involved in the electricity market should publish information. Those standards cover all the way from nuclear power plants to small renewable energy sources. This is also applicable to national electricity grids and big industrial consumers. The final goal of this standardization is to make this market, which is becoming increasingly complex, much more transparent. So, we now have vast amounts of knowledge about the electricity network and all the electricity infrastructure of Europe as semantic data. We are seeing growing demand from electricity management companies, mainly the operators of the grids. They want to use semantic technology to better use information that is already available.

***Your flagship product is GraphDB. Can you tell us more about what it does and some of its most common use cases?***

Yes, this is our most popular product and I can share two use cases. I already spoke about managing the information about all the devices in a building, so I'll give you another one. Think of a big retail bank. This bank is a real user, one of the biggest retail banks in the USA. It collects monitoring information from its most critical IT systems internally and then integrates it using GraphDB for better root-cause analysis. One practical example would be whenever there is a malfunction in one of the bank's ATMs, GraphDB helps by reducing the time for root-cause analysis.

Apart from this application, GraphDB can also provide vulnerability analysis. Think of the same bank having information from the HR department about all the system operators and which people have access rights to which of these systems. What if any of these people get mentally ill and decide to act in a harmful manner? What would be the potential impact? GraphDB can analyze the impact of a single person.

For the pharmaceutical industry, we have a special pre-packaged solution related to drug development. Researchers have to identify proteins in the body that this new drug should target to achieve a specific purpose, let's say to cure leukemia. Identifying such targets is a prolonged process because the number of hypotheses researchers have to check often goes in the thousands. We have this solution that is already implemented in some biotech and pharma companies, where we essentially integrate publicly available medical databases and information from medical research papers and publications on specific topics. The final goal is to make excellent suggestions on what could be the best set of candidate targets that the researchers should, at the end of the day, consider and decide on.

***Do you have any new versions or features of the GraphDB in the pipeline and what business needs would they address?***

We recently released a major version of GraphDB, where the most important thing is to make it much easier for engineers and IT people to start with it and develop their applications.

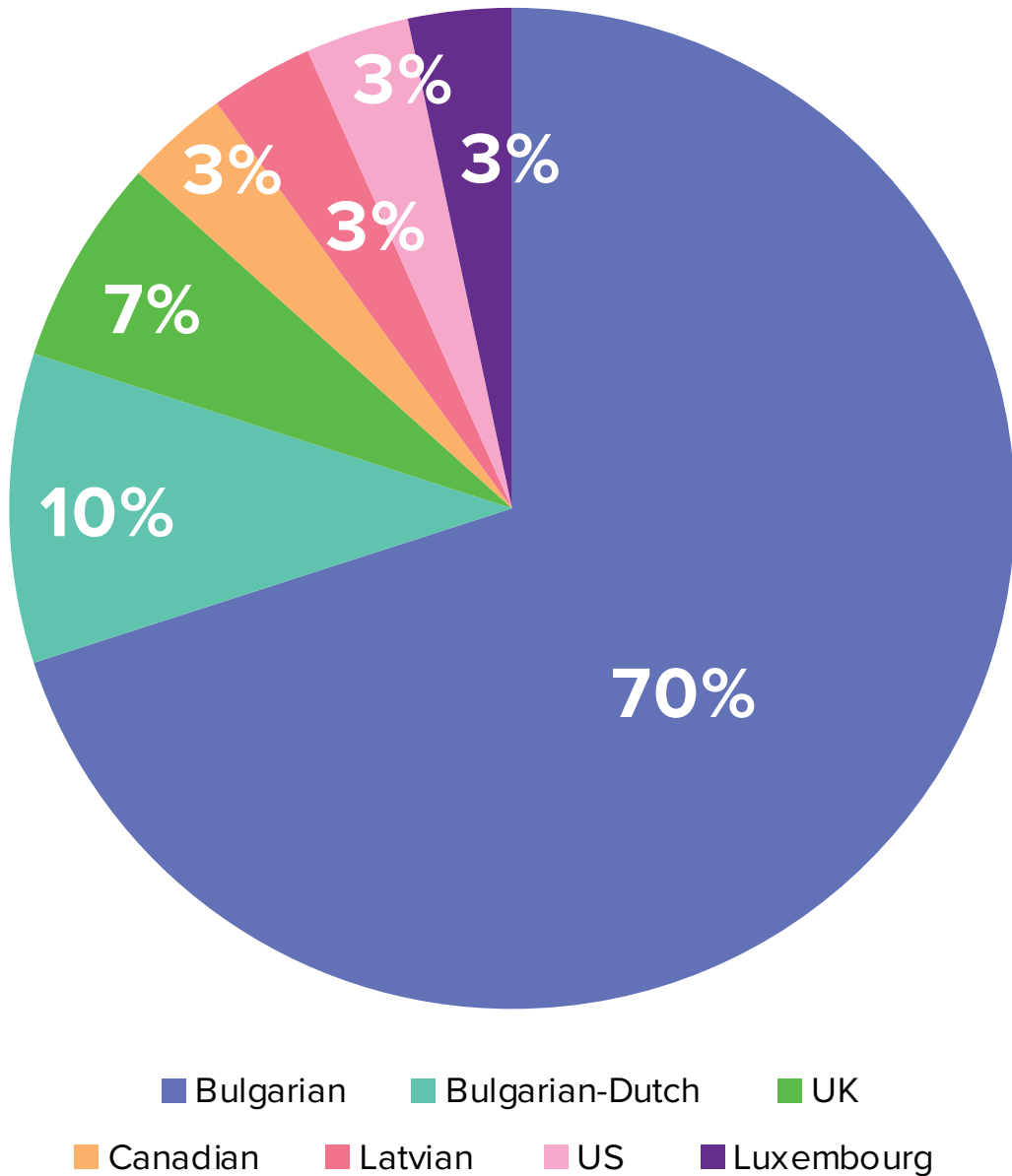
Historically, this technology was mostly used by the so-called early adopters – technically skilled, very advanced engineers who could deal with the technology, even if some of the features were not so straightforward. This was okay in the early phases of adopting this technology when the total number of customers who used it for critical production purposes was not too big. However, now that this technology is becoming mainstream, we must make it much more user-friendly and easier to maintain and support.

# Distribution of companies by ownership

Bulgarian entrepreneurs have a strong presence on the local AI scene as 70% of the companies in the field are solely-owned by Bulgarian individuals or companies. Another 10% of the companies are

co-owned by Bulgarian and Dutch investors, with the aforementioned holding majority stakes in all cases.

**Fig. 2** Share in total number of AI cos

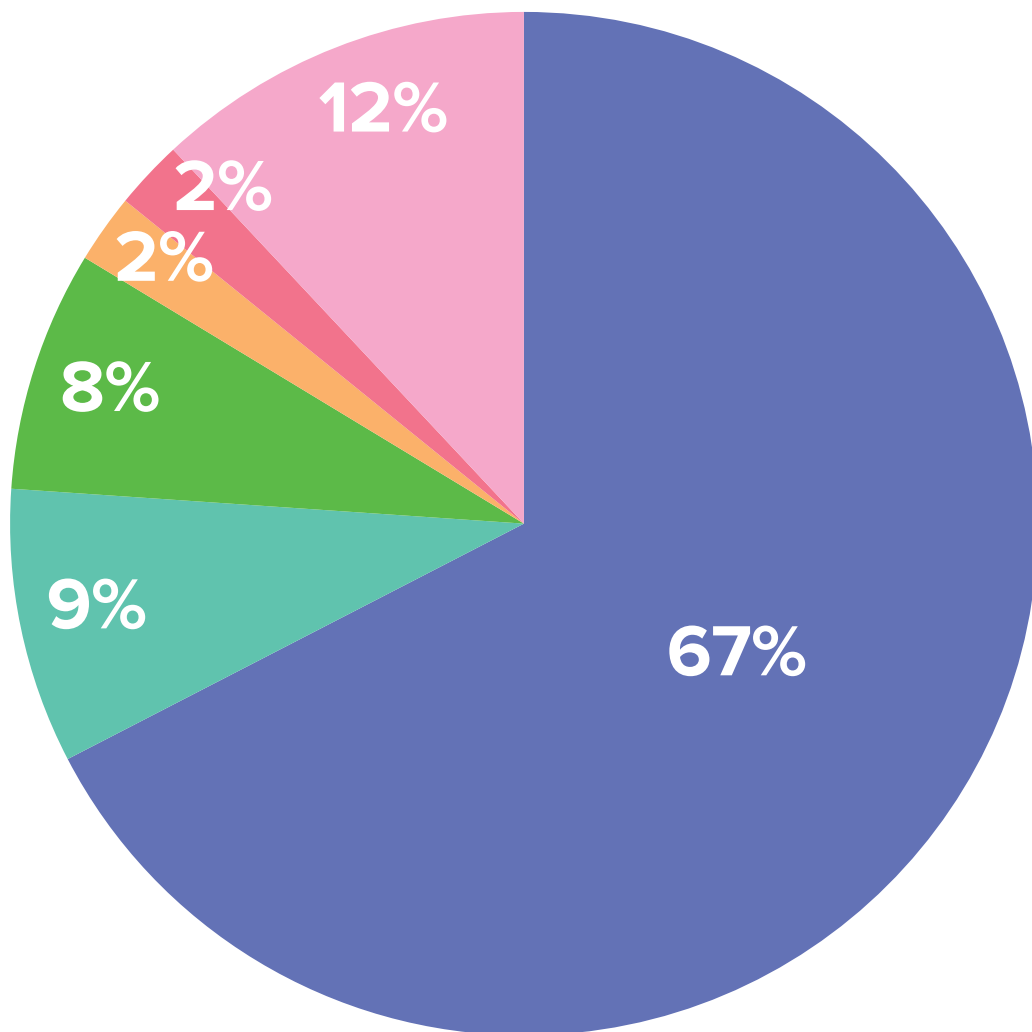


# Overview of non-AI companies with AI capabilities

The Bulgarian AI ecosystem is enhanced by a number of enterprises which are developing or using AI technologies to complement their main activities. These companies, ranging from small entities to local arms of multinational corporations, have a significant contribution to Bulgaria's economy – their combined total revenue surpassed EUR 1.1 bln in 2021. Moreover, these companies come from a great variety of sectors,

reflecting the widening need for AI-enhanced solutions across the national economy. It is hardly a surprise, however, that the bulk of companies that are not purely AI-focused but use such capabilities are specialised in computer programming, consultancy and related activities, a sector which has grown exponentially over the last decade, thus positioning Bulgaria among the leaders in the IT industry in Southeast Europe.

**Fig. 3** AI-related companies by sector



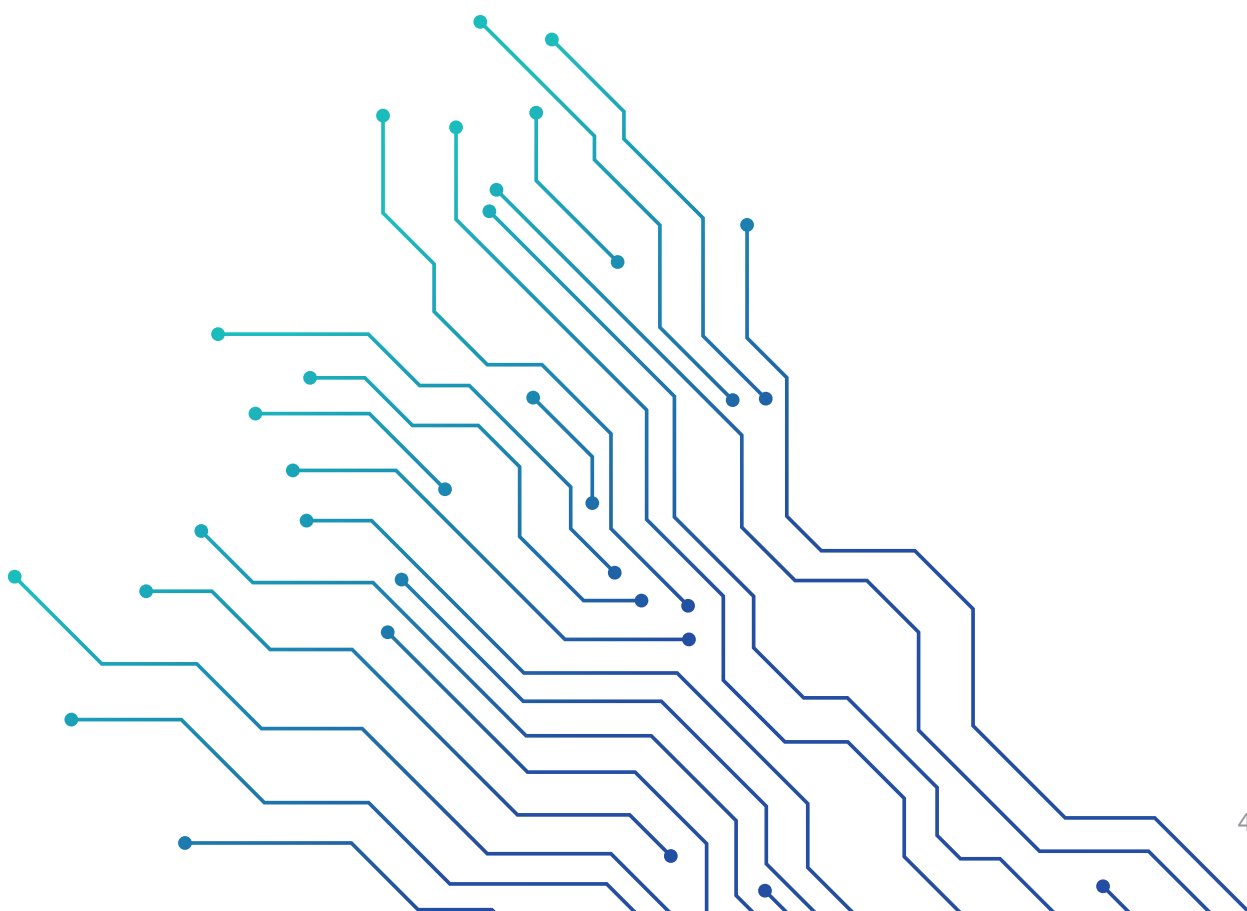
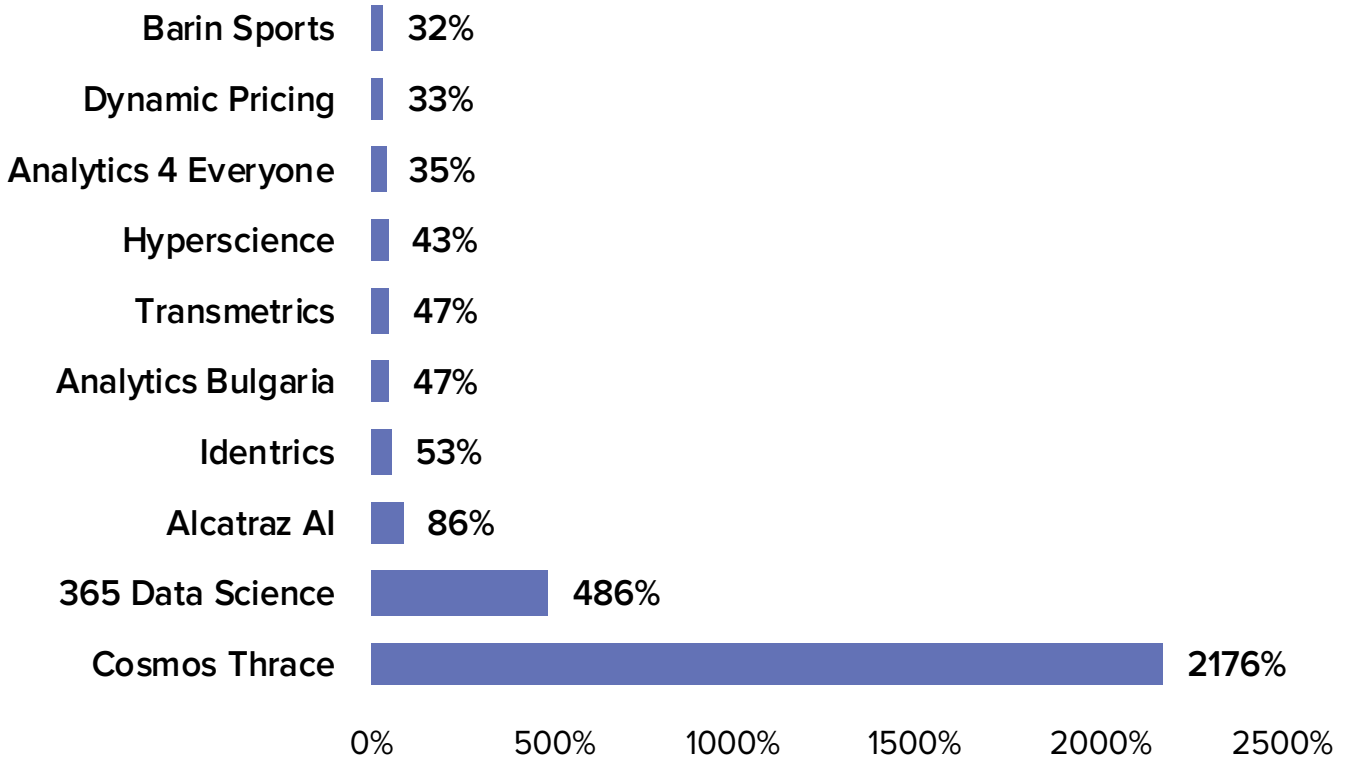
- Computer programming, consultancy and related activities
- Other professional, scientific and technical activities
- Information service activities
- Manufacture of computer, electronic and optical products
- Activities auxiliary to financial services and insurance activities
- Other

# Most dynamic companies by revenue

In 2021, the top 10 most dynamic companies by operating revenue accounted for more than half of the industry's aggregate revenue. They also

contributed EUR 3.5 mln more to the top line than they did in 2020 and almost EUR 7 mln more in comparison to 2019.

**Fig. 4** AAGR in operating revenue for 2021-2020



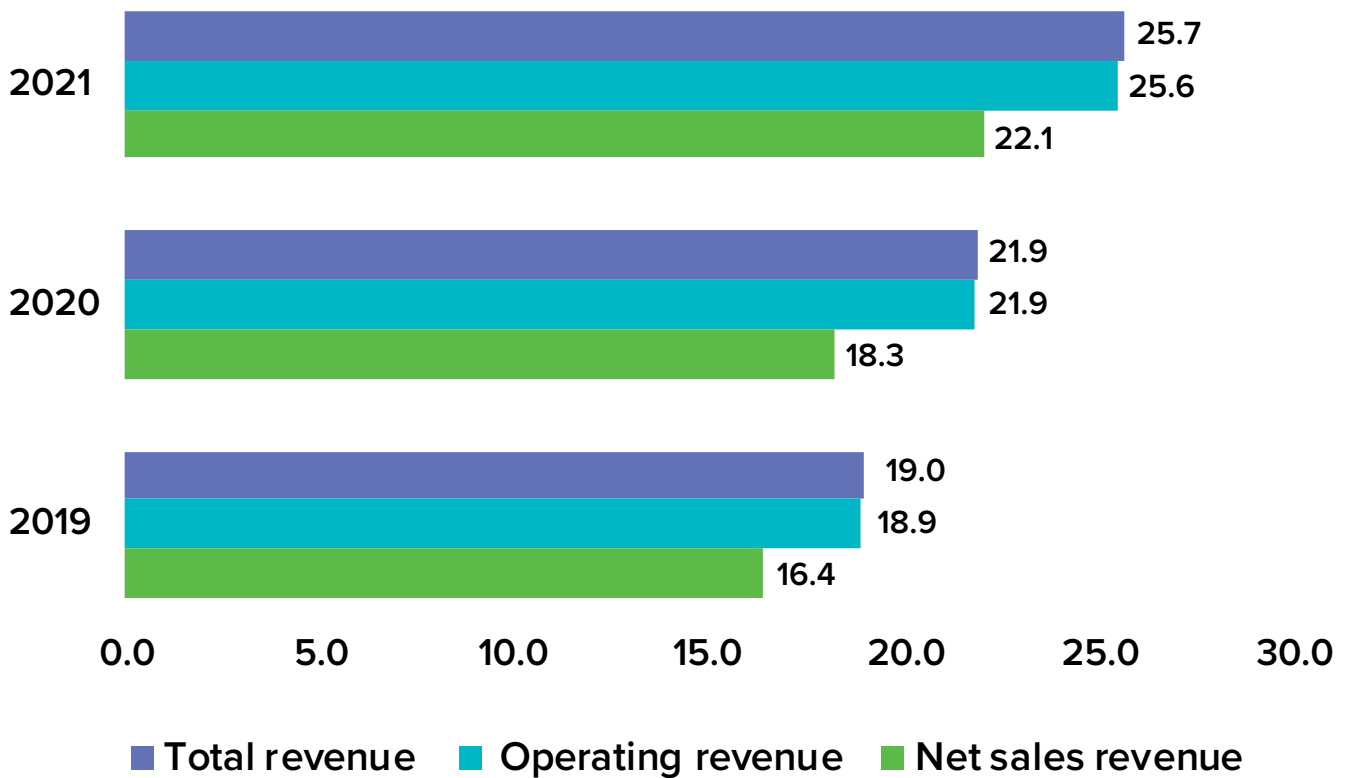
# Market Size

## Revenue analysis

Bulgarian AI developers enjoyed substantial growth in revenues throughout the 2019-2021 period. Their combined total revenue reached the record-high EUR 25.7 mln in 2021, a surge of more than 35% the sum in 2019. In comparison with 2020, the sector booked EUR 3.8 mln more revenue in 2021 than in the previous year which represents a solid annual growth rate of 17.3%. The uptrend in total revenue came on the back of a strong rise in operating and net sales revenues. The increase in net sales revenue was especially

evident with an year-on-year jump of 21% in 2021 or nearly double the growth rate of 11% registered in 2020. Operating revenue also grew, albeit at a slower rate of 17%, slightly accelerating from the 16% increase recorded in 2020. The impressive increase in the net sales revenue shows that Bulgaria-developed AI products and services are catching the eye of more and more customers and the market has a promising potential for years to come.

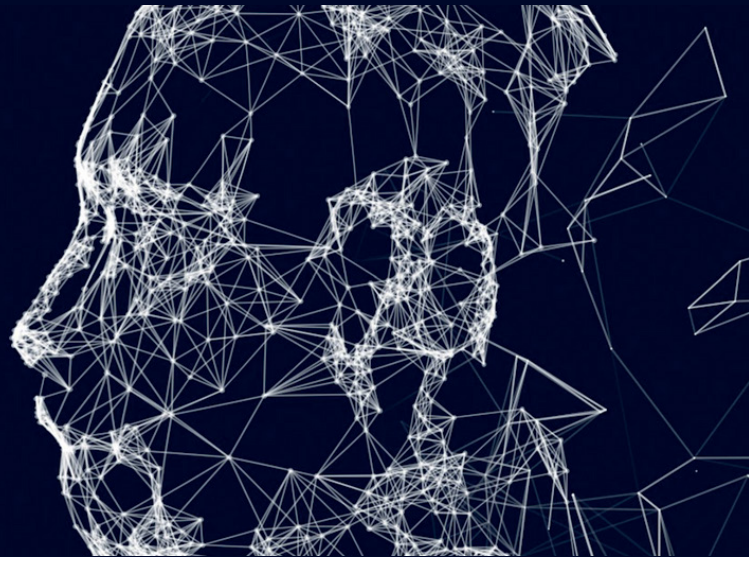
**Fig. 5** AI Market Revenues (EUR mln)



# AI CLUSTER BULGARIA

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## SPREADING THE DEVELOPMENT AND ADOPTION OF AI



**AI | BULGARIA** is a professional non-governmental organization committed to building a sustainable ecosystem in the Artificial Intelligence sector following the cross-technology cross-regional and cross-community approach. The cluster aims to:

- Promote research in, and responsible use of AI
- Increase public understanding of AI
- Improve the teaching and training of AI practitioners, and
- Provide guidance for research planners and funders concerning the importance and potential of current AI developments and future directions.

**Are you an Entrepreneur, Investor, Scientist or Business owner?**

**Does Your Project Need Artificial Intelligence?**

**What AI can do for You?**

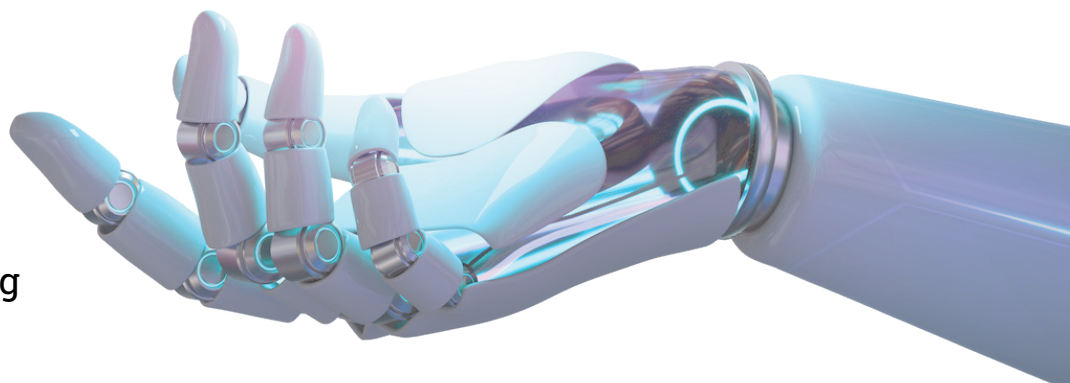
**Do you want to be part of a Thriving Deep-tech Ecosystem?**

**We Have a Solution!**

## Key Technologies

The cluster is bringing the knowledge for ML, NLP, IoT, AR, VR, Computer Vision, Big Data, Cloud Computing and Networking Interconnectivity.

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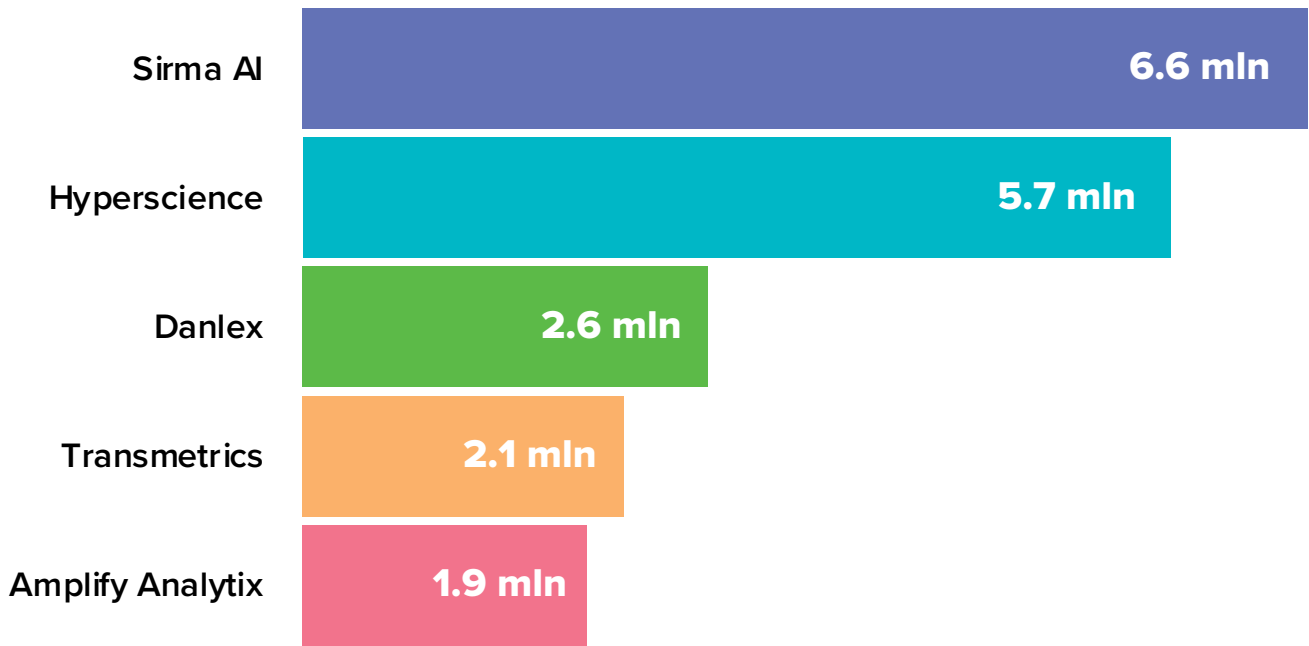


# Top 5 by revenue

The leading five AI companies in terms of revenue accounted for 74% of the market's total size in 2021. Their combined total revenue topped EUR 19 mln, representing an annual jump of 26% and a sharp acceleration from the 7.3% increase recorded in 2020. All of the top 5 companies reported a rise

in total revenue in 2021, while annual growth rates ranged widely - from just 1% to the whopping 62%. Thus, the five leaders added almost EUR 4 mln more to the market's total in 2021 in comparison to the previous year.

**Fig. 6** Total revenue 2021 (EUR mln)

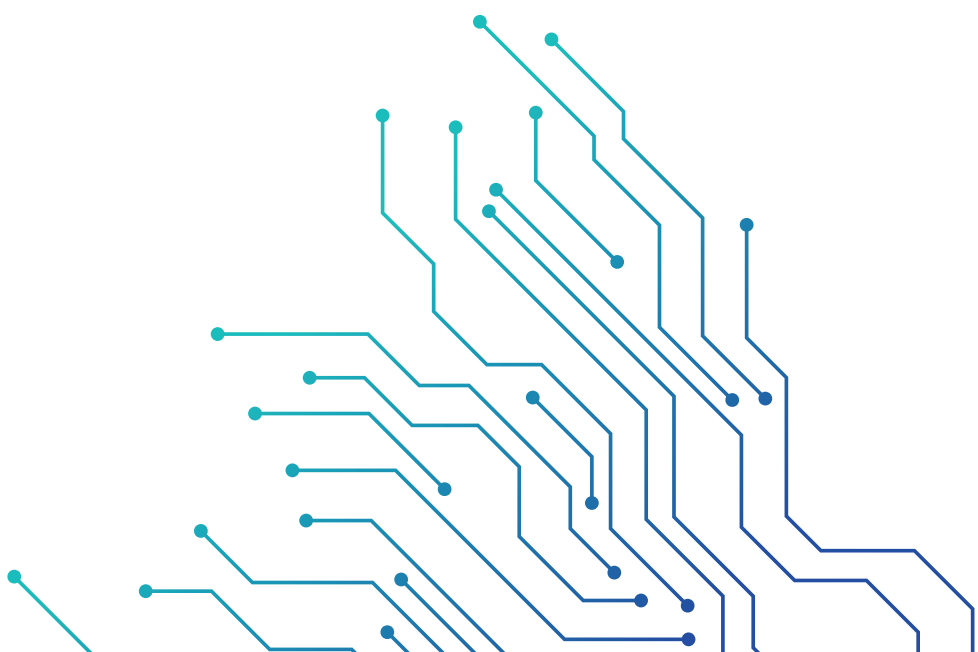
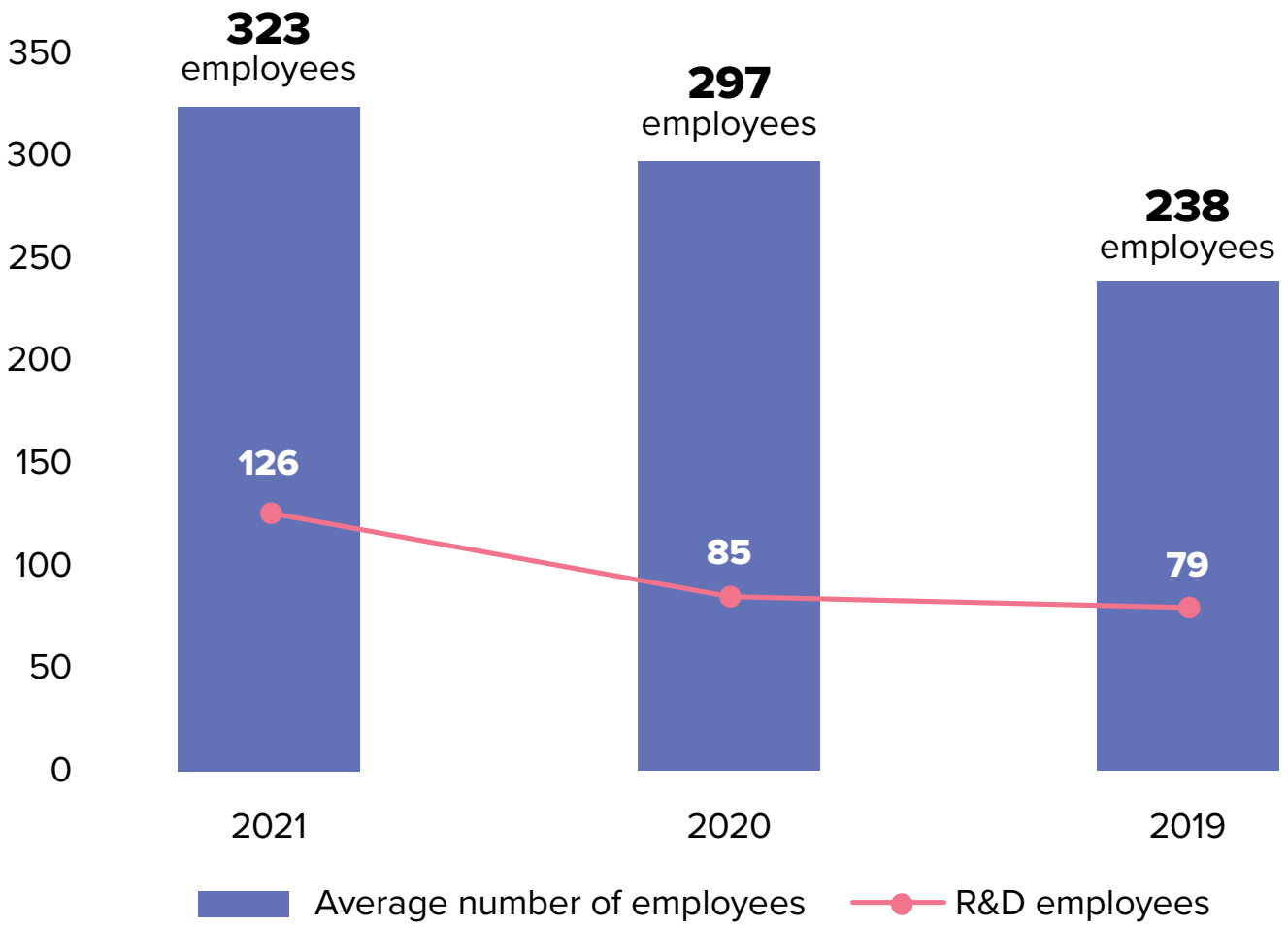


# Employment analysis

AI developers hired more staff in the period under review and in 2021 employees reached 323 people. Despite the overall uptrend, the annual increase in 2021 slowed down to 8.8% from the record-high 25% in 2020. According to official data, in 2021 nearly 40% of the employed were engaged

in R&D activities, up from 29% in 2020. The R&D staff in AI accounted for 7% of the total number of R&D employees in Bulgaria in 2021, thus reflecting the sector's growing importance for technological progress and innovation in the country.

**Fig. 7** Number of employees

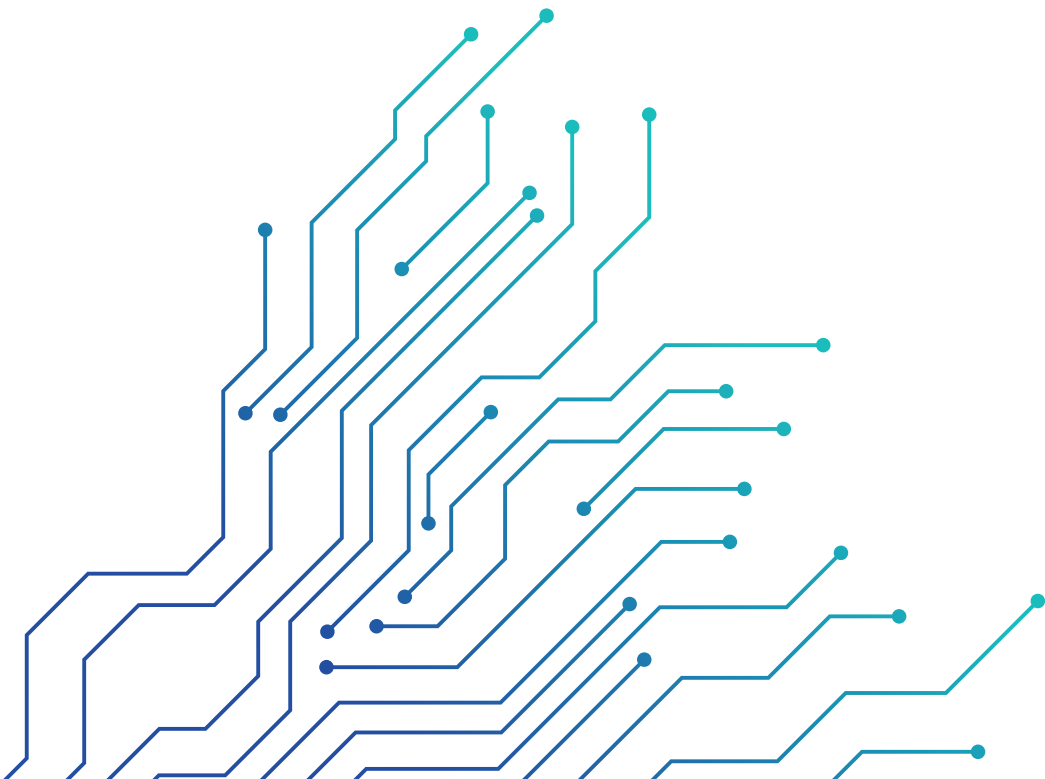


# Top 5 employers

The top 5 employers on the Bulgarian AI market were actively hiring in the period 2019-2021. They employed 23% more people compared to the previous year in both 2021 and 2020, thus

accounting for 67% of the total employment in the sector in 2021. In number terms, the staff of the leading five employers averaged 217 people in 2021, up from 176 a year earlier and 143 in 2019.

**Fig. 8** Top 5 companies by average number of employees in 2021

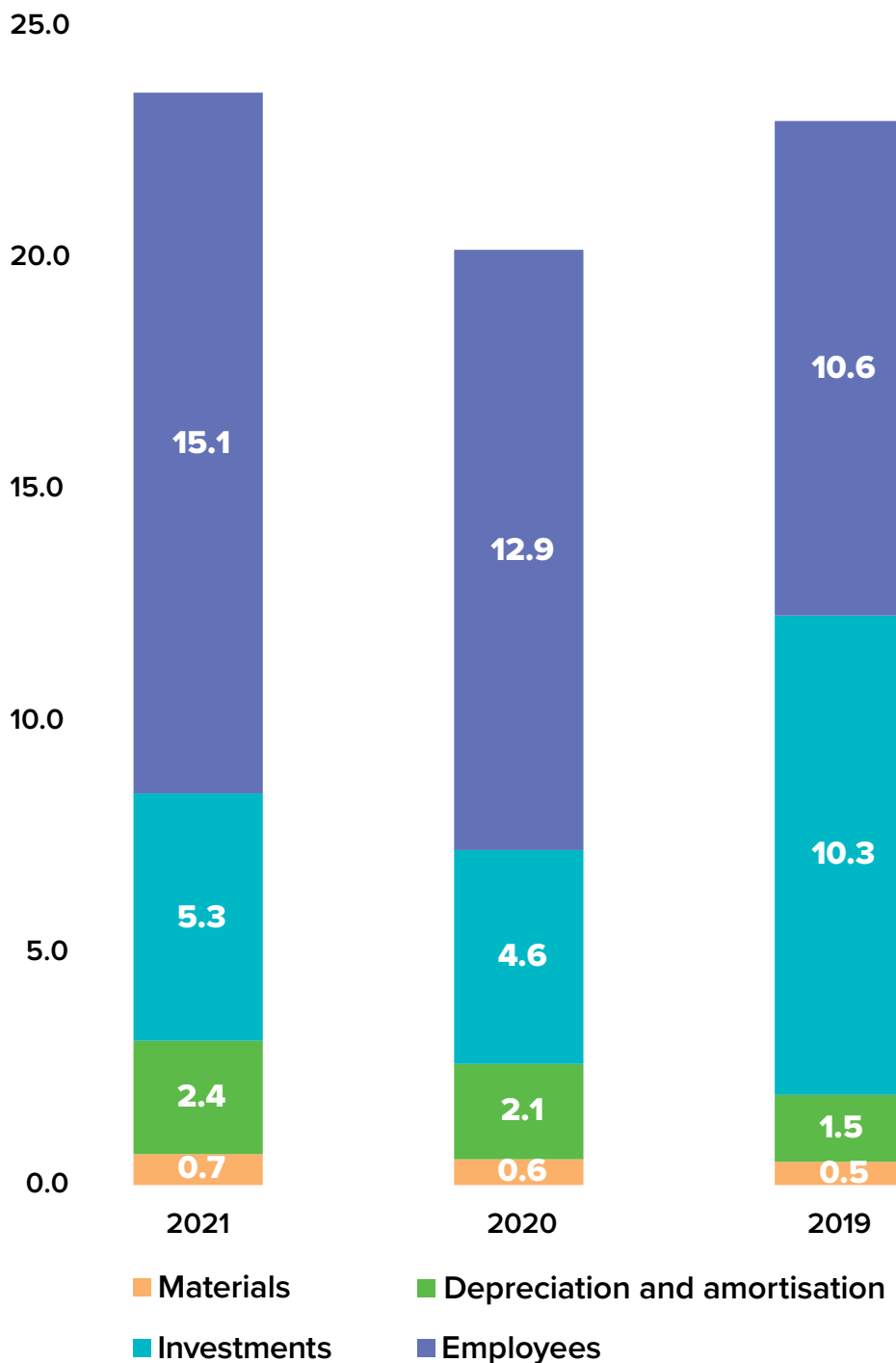


## Cost analysis

The dynamic development of Bulgarian AI companies brought not only higher revenue and employment but rising costs as well. In 2021, total costs for employees, materials, depreciation, amortisation, and investments (including R&D expenses) totalled EUR 23.5 mln, up by 17% compared with 2020. Among the different types of costs, expenses for materials jumped the most, by 22%, but their share of total costs remained the lowest – 2.9%. Depreciation and amortisation

costs grew at the second-highest rate, of 17.4%, while their share in the total remained almost unchanged at 10.3%. AI developers spent 16.9% more on employees in 2021 than in 2020, with labour costs slicing the highest share of the total expenses, of 64%. Naturally, investment spending, including R&D costs, is also important for Bulgarian AI companies – 23% of total costs were earmarked for investments, which is an year-on-year increase of 15.6%.

**Fig. 9** Costs dynamics (EUR mln)



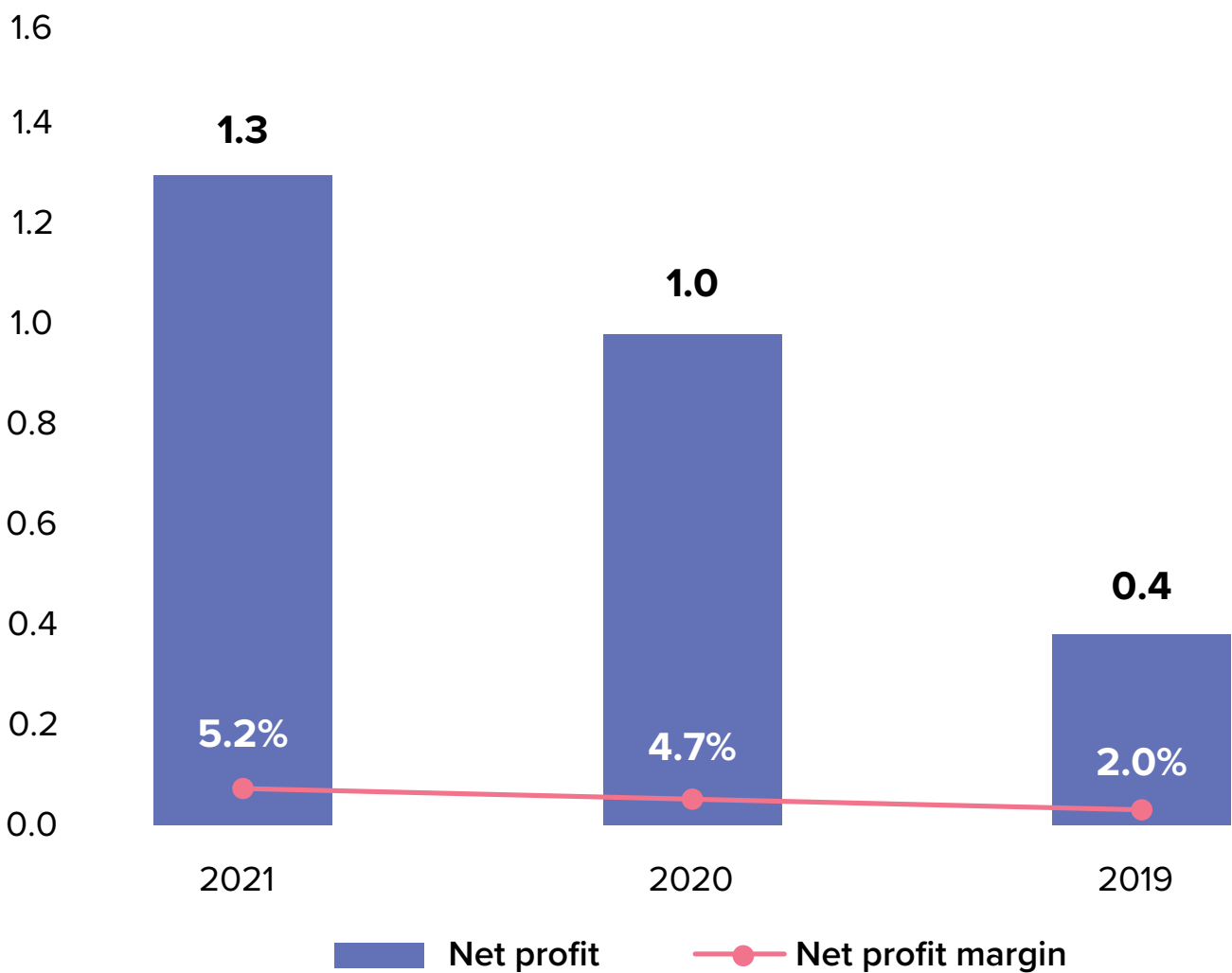
# Profitability analysis

Bulgaria's AI market enjoyed a strong 2021, with their combined net profit jumping 31% to EUR 1.3 mln. Despite the impressive overall result, the number of companies in the red was a bit higher than that of profitable companies, reflecting the volatile nature of the sector and the traditionally longer life cycle of companies that rely heavily on R&D and innovation. However, Bulgarian AI companies stand their ground – 2021 was the

third consecutive year with a profit booked and an increase in the bottom line.

Average net profit margin reached 5.2% in 2021,, up from 4.7% in 2020 and 2% in 2019. Net profit per employee also improved, surpassing EUR 4,100 in 2021, after more than doubling in 2020 to over EUR 3,400.

**Fig. 10** Net profit (EUR mln) and net profit margin



# Identrics believes in technology's future but knows humans are irreplaceable

*Identrics is a research and development company that creates award-winning AI solutions. Its solutions turn unstructured data into understandable knowledge and valuable insights.*

*The company obtains accuracy close to a human's by utilising various approaches such as text mining, natural language generation (NLG), and natural language processing (NLP). Identrics offers insights about any volume of text in any major language using machine learning.*

*The CEO of Identrics, Vladimir Petkov, shared his perspectives on the current state of artificial intelligence, including its ethical issues and what to expect next from Identrics.*



**Vladimir, you are well known for your thoughts and expertise regarding Ethics in AI. What is ethical AI, and what are some of the key ethical issues you think AI faces?**

It is generally agreed upon that responsible AI means using AI in ways that do not harm people. Companies developed guidelines to ensure they are following specific rules that match the organisation's core values. These guidelines typically address issues such as liability or safety.

Several ethical issues need to be addressed as part of data science. These include prejudice based on race, political orientation, gender, hallucinations, factual inconsistencies, and hate speech. The data collection for machine learning models affects how well they work, which can lead to problems with bias.

**Can you give us examples of AI and machine learning solutions in which you have integrated additional algorithms to guarantee they cover the Ethical AI principles?**

The ethical principles that are most commonly known are:

- Fairness
- Reliability & Safety
- Privacy & Security
- Inclusiveness
- Transparency
- Accountability

In Identrics, we are excited about creating AI and machine learning models, but at the same time, we understand the huge responsibility we have to develop an ethical technology.

Therefore, our work is fine-tuned with additional algorithms to avoid biases, factual inconsistencies, hallucinations, hate speech, etc.

We can prevent the non-ethical behaviour of models by ensuring that data used to train them is unbiased, monitoring and controlling them, fact-checking and storing data appropriately, learning from past mistakes with model improvement processes such as the Human Information Processing (HITL) cycle, monitoring and detecting anomalies in production environments, and reassessing training data regularly.

In 2021, Identrics won a Gold Stevie® Award for Content Management Solutions with our Abstractive summarisation solution. Our technology is enriched with additional algorithms that ensure the high quality of the text and cover ethical standards.

In the Abstractive summarisation, we performed validation of all prompts, fact-preserving and fact-checking, and a "bad words" filter to sort toxic language. By the prompt engineering of the validation steps, absolutely all of the prompts were caught by the validation procedures. The feedback from users confirmed that the validated content was now correct and 100% inoffensive.

We believe in the future of technology, but we know that the role of humans is irreplaceable. AI and machine learning models are invented and created by people with the intent to make other people more flexible, creative, and effective. If we decide to give machines the ability to make autonomous decisions, we need to be very careful and have many safety systems in place to ensure that not a single person will get hurt.

**Disinformation is also a topic nowadays. Do you think AI technologies can be used to detect it?**

The world is facing a growing problem with disinformation and hate speech. Thanks to new technologies and social networks, fake news is more significant than ever before, aiding the spread of both disinformation and propaganda. In this case, technology can be both a stimulus and a solution to these problems.

Identrics has the experience of extracting information from open sources and turning it into knowledge in a short period. We monitor over 100 000 sources, collect data on more than 1.5-2 million articles daily, and use the information to deliver new insights to our clients.

We provide solutions to help you detect hate speech and disinformation in comments on blogs, news sites, forums, or other online communities. The latest projects we are working on with partners include machine learning models for detecting and alerting hate speech and propaganda.

The variations of this solution are:

- hate speech for media and social platforms
- style based disinformation detection
- knowledge-based disinformation detection
- propagation-based disinformation detection
- source based disinformation detection

**What to expect from Identrics in 2023?**

We have been working on two major products for quite some time now. In 2023, we are planning to release both.

One of the projects is Kaspian, a big data delivery platform that deals with sizable data warehouses and organises them into data streams. What Identrics provides through Kaspian is a solution for a quick and simple setup procedure, full document access, and global monitoring. We are preparing to implement all of Kaspian's features in the upcoming year.

Something else we have been developing is Topify. This is a product we have been working on for over a year. It is a tool for quantifying internet news that clusters information, provides a broad overview of new topical trends, and delves deeply into the parameters that drive them.

# Methodology

The AI report in Bulgaria covers the period 2020-2022. We have carried out a thorough desktop research to identify the companies operating in the AI field in Bulgaria from a pool of entities active in relevant industries. The initial pool of companies was gathered from several main sources, including Bulgaria's Trade Register and AI Cluster Bulgaria. Each of the companies in the pool was researched individually in order for our team to determine its relevance and whether its core operations are focused on AI development or an activity complementary to the main business. The companies which are not fully engaged in AI were classified as "non-AI companies with some AI capabilities". The final pool of companies focused entirely on AI was used for the financial analysis in the "Vendors landscape" and "Market size" chapters of this report. The "Vendors landscape" chapter also features an overview of the non-AI companies with AI capabilities. We used official company data to prepare the analysis in both chapters - the analysis on distribution of companies by ownership was based on Trade Register data for beneficial owners (where available); the analysis of the non-AI companies features data on sectors based on the Classification of Economic Activities (KID-2008) of the National Statistical Institute (NSI).

## Financial analysis methodology

We used the official non-consolidated company records of all vendors to collect information about the financial indicators mentioned in the report – revenues, costs and profitability for three consecutive years - 2019-2021. The original figures were in BGN and were calculated in EUR using the official fixed exchange rate EUR = BGN 1.95583. Employment data is based on the average number of employees for the respective year. Net profit margin is calculated based on total revenue for the respective year.

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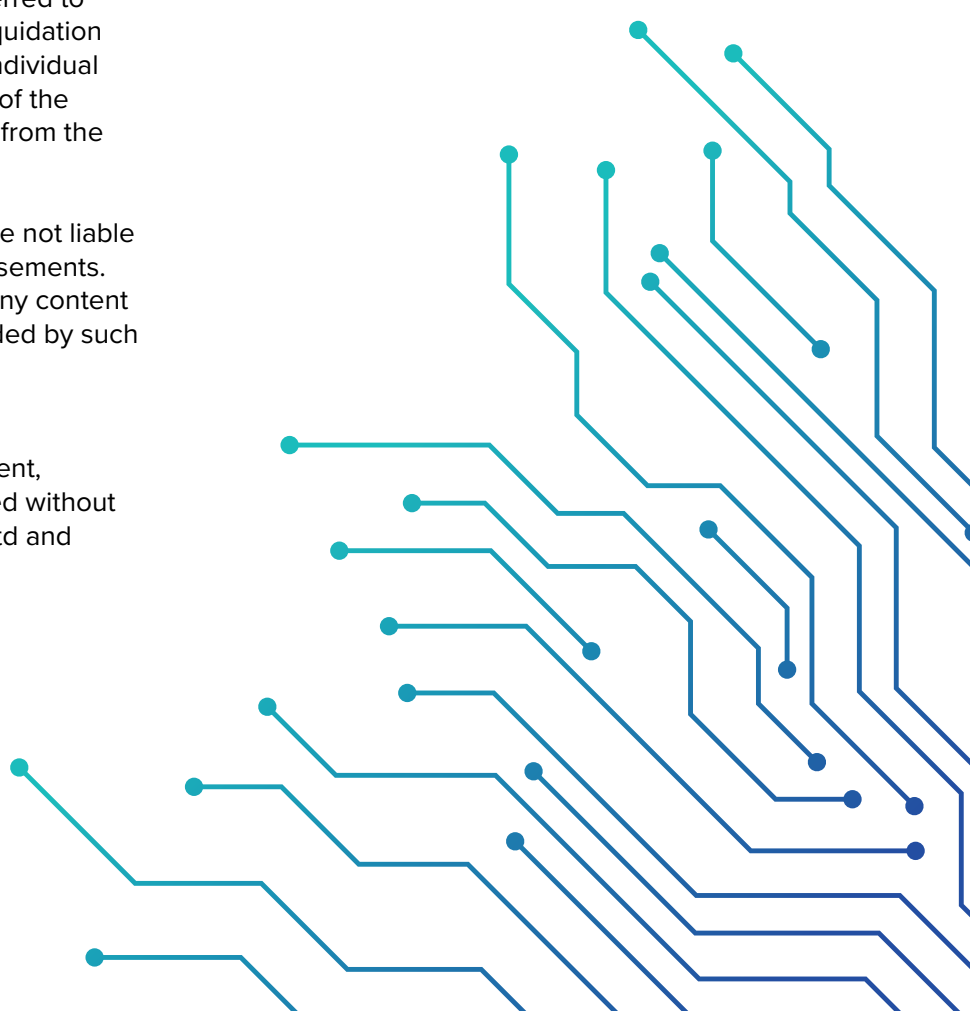
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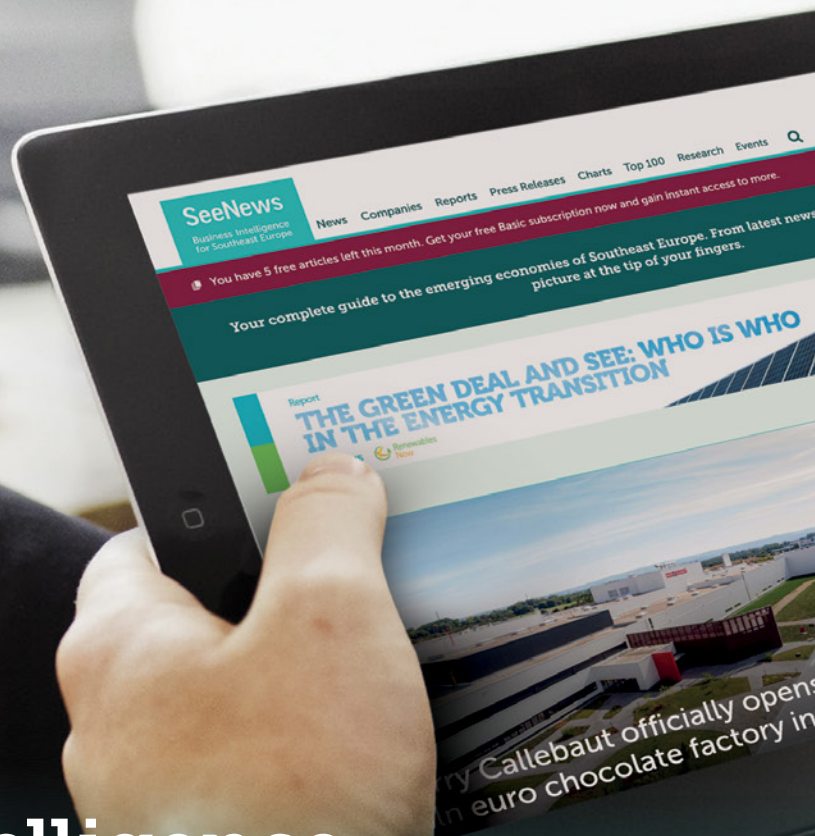
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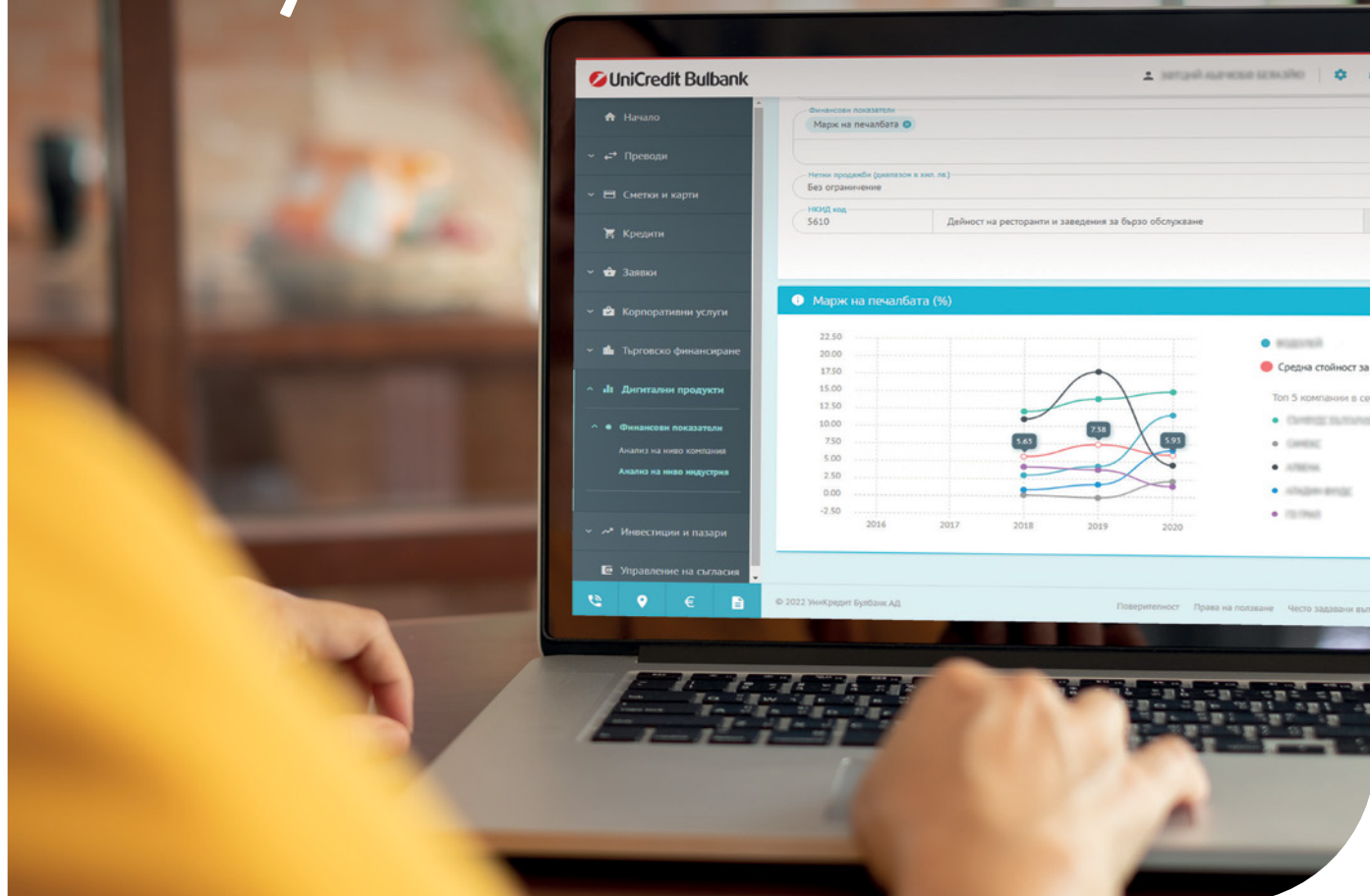
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