



Republic of Croatia  
Ministry of Economy,  
Entrepreneurship and Crafts

# CROATIA INDU STRY 4.0

OPPORTUNITIES



# Croatia - Industry 4.0 Opportunities



**Republic of Croatia**  
Ministry of Economy,  
Entrepreneurship and Crafts

November, 2019

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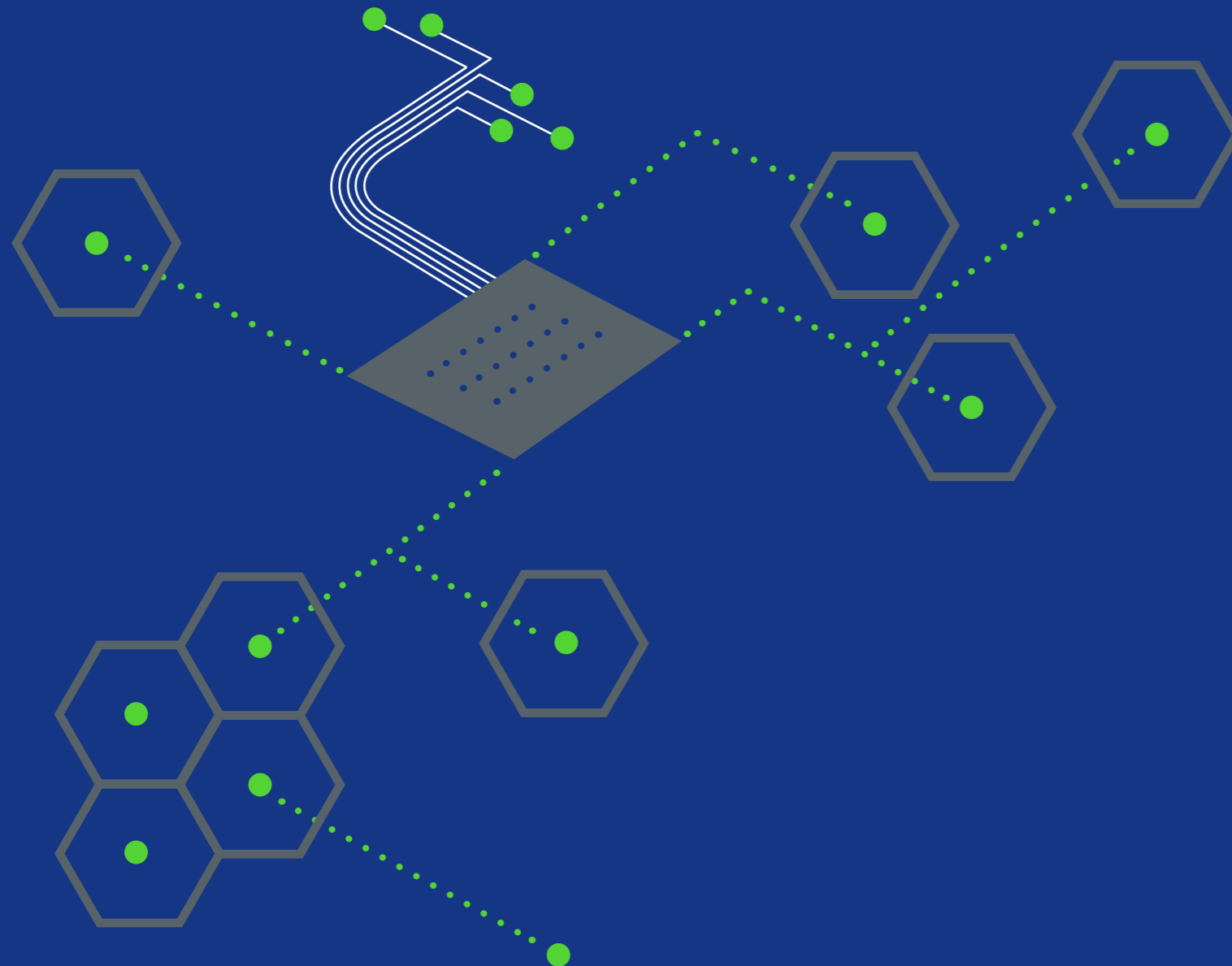
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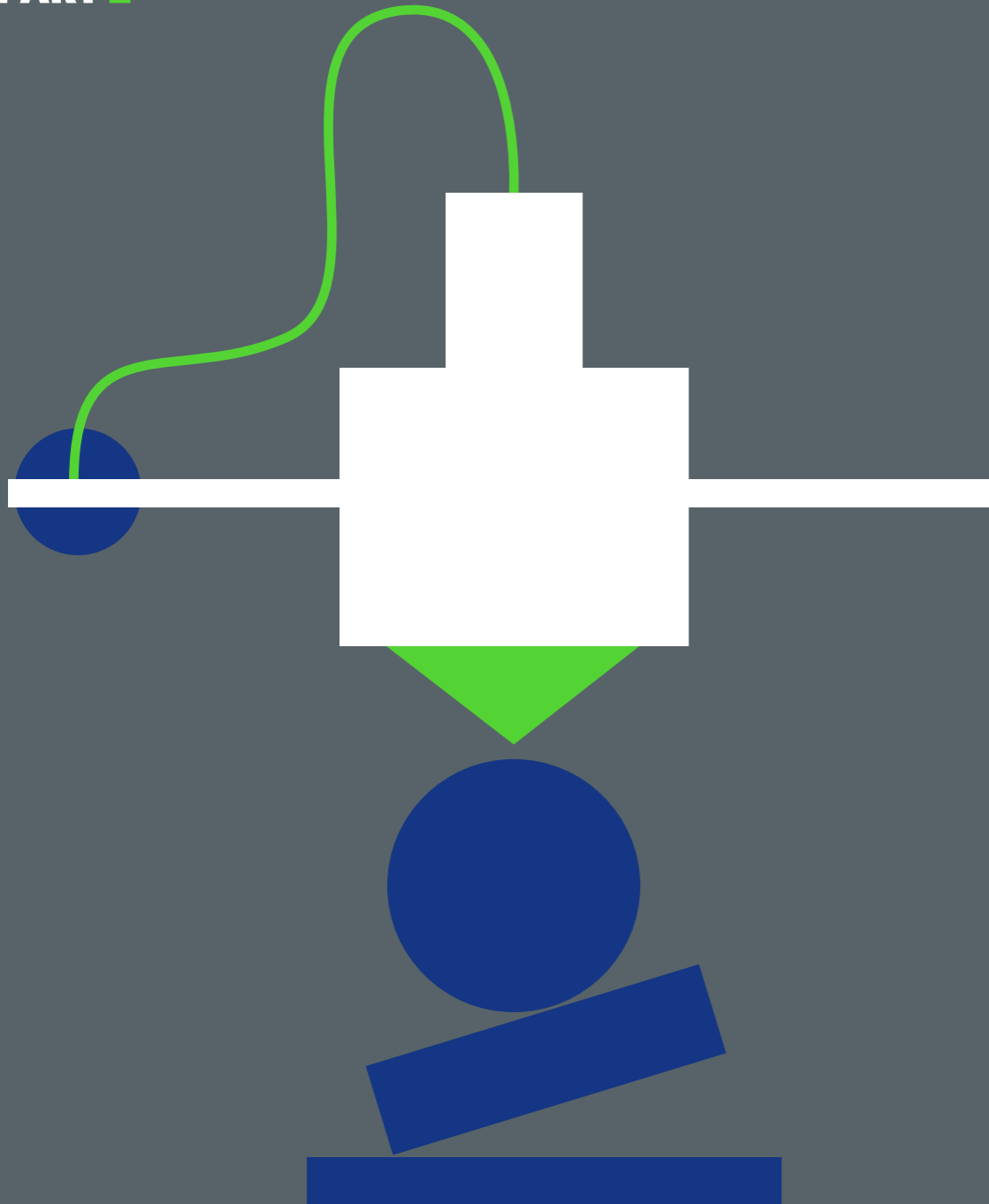
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# INTRODUCTION

Breakthroughs in digital technologies, such as AI, robotics, and IoT, combined with the convergence of technologies, such as nanotechnology, biotechnology, and material sciences, are transforming products, processes and business models in all sectors. Current production systems, and global value chains, are becoming more dynamic, flexible, efficient and sustainable, with high possibilities for customisation and personalisation. This publication aims to give an overview of the digital transformation taking place in Croatia with a specific focus on particular subfields of Industry 4.0 and the main actors and investment opportunities, as well as available institutional support.





# **OVERVIEW OF THE CROATIAN DIGITAL ECONOMY AND SOCIETY**

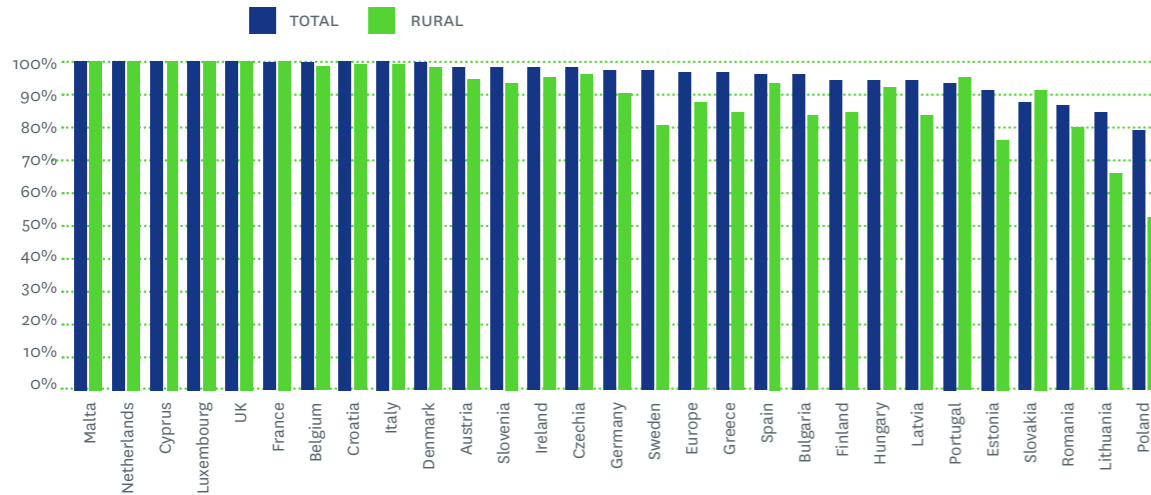
**Croatia is committed to the advancement of new digital technologies and is currently in the process of developing a national plan for the digital transformation of the economy.**

2.1.

## Digital infrastructure and the integration of digital technology

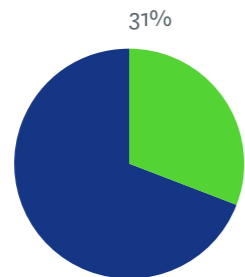
According to the Digital Economy and Society Index 2019, Country Report Croatia, Croatia performs well in fixed broadband coverage (above the EU average) and has improved its 4G and NGA coverage. 5G trials have been ongoing since 2017, and the first 5G commercial networks are expected to start operating in 2020.

**FIXED BROADBAND COVERAGE (% OF HOMES), MID-2018**  
SOURCE: DIGITAL ECONOMY AND SOCIETY INDEX 2019

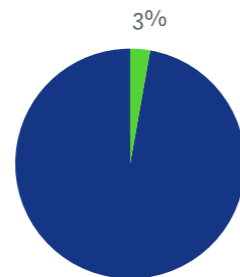


Integration of digital technologies among Croatian firms varies among sectors and firm sizes. According to Eurostat, more than 30% of enterprises use cloud computing (26% is the EU average), while the use of 3D printing and big data analysis is close to the EU average.

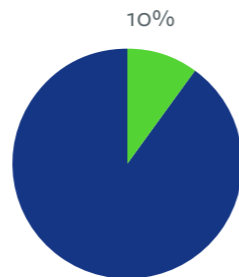
**INTEGRATION OF DIGITAL TECHNOLOGY**  
SOURCE: EUROSTAT 2019 FOR 2018



ENTERPRISES USING CLOUD COMPUTING SERVICES



ENTERPRISES USING 3D PRINTING



ENTERPRISES ANALYSING BIG DATA FROM ANY DATA SOURCE



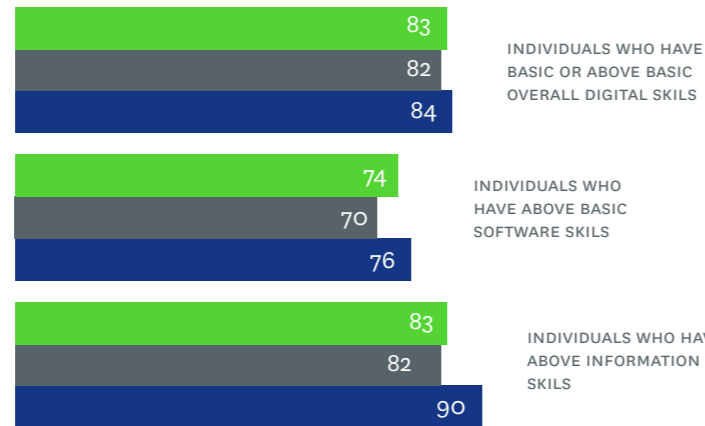
2.2.

## Human capital

According to the digital skills indicator surveyed by the European Union, the share of young people in Croatia who have basic or above basic overall digital skills, above basic software skills and above basic information skills is higher than the EU average.

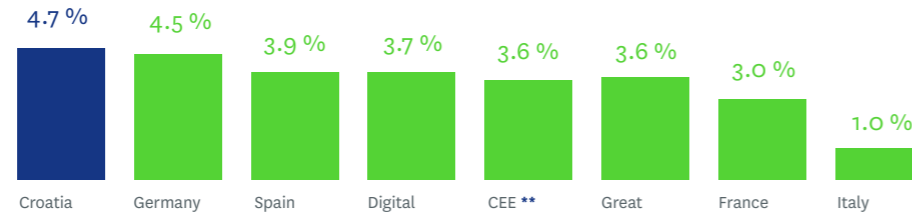
**SKILLS - PERCENTAGE OF INDIVIDUALS, 16-24 YEARS OLD**  
SOURCE: EUROSTAT 2019 FOR 2017

■ EU 15  
■ EU 28  
■ CROATIA



Moreover, ICT graduates in Croatia represent a high share of the student population – above CEE and Digital Frontrunners.

**INFORMATION AND COMMUNICATION TECHNOLOGY GRADUATES, % OF ALL GRADUATES**  
SOURCE: MCKINSEY & COMPANY – CROATIA – EMERGING DIGITAL CHALLENGER 2018



\* Belgium, Denmark, Estonia, Finland, Netherlands, Ireland, Norway, Luxembourg, Sweden

\*\* Bulgaria, Croatia, Czechia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia

In regard to language skills, according to the 2019 Language Barometer conducted by the market research agency Henda, almost all citizens of the Republic of Croatia stated that they know the English language at least at basic level (95%). Half of them speak German, while almost a quarter of Croatian residents are familiar with the Italian language.

To actively stimulate job creation and increase the number of digital professionals employed in Croatia, the National Coalition for Digital Skills and Jobs was established in 2018.

URL: <https://digitalnakoalicija.hup.hr/koalicija/>

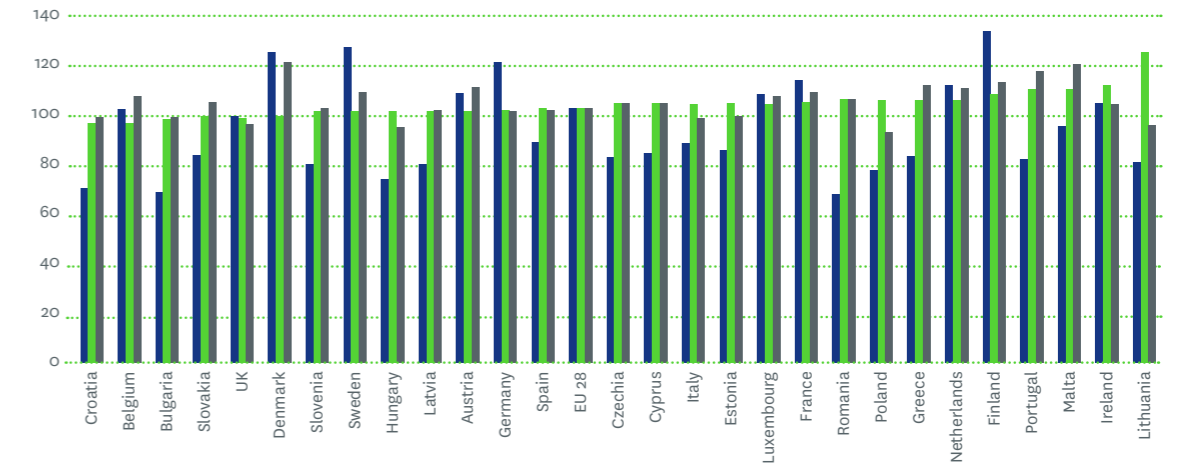
2.3.

## Investment costs

According to Eurostat, price levels for investments in Croatia are 32% lower than the EU average, with price level indices for software being the lowest in the whole EU.

**PRICE LEVEL INDICES FOR INVESTMENT**  
SOURCE: EUROSTAT 2019 FOR 2018

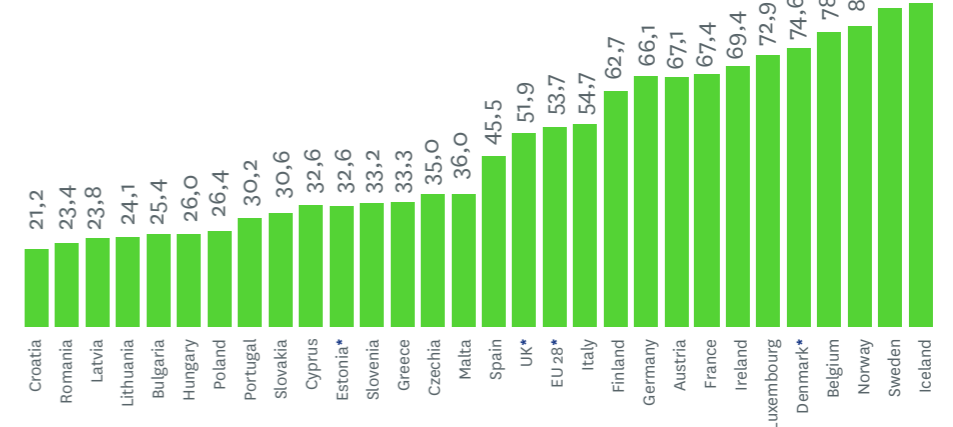
■ INVESTMENT  
■ SOFTWARE  
■ MACHINERY AND EQUIPMENT



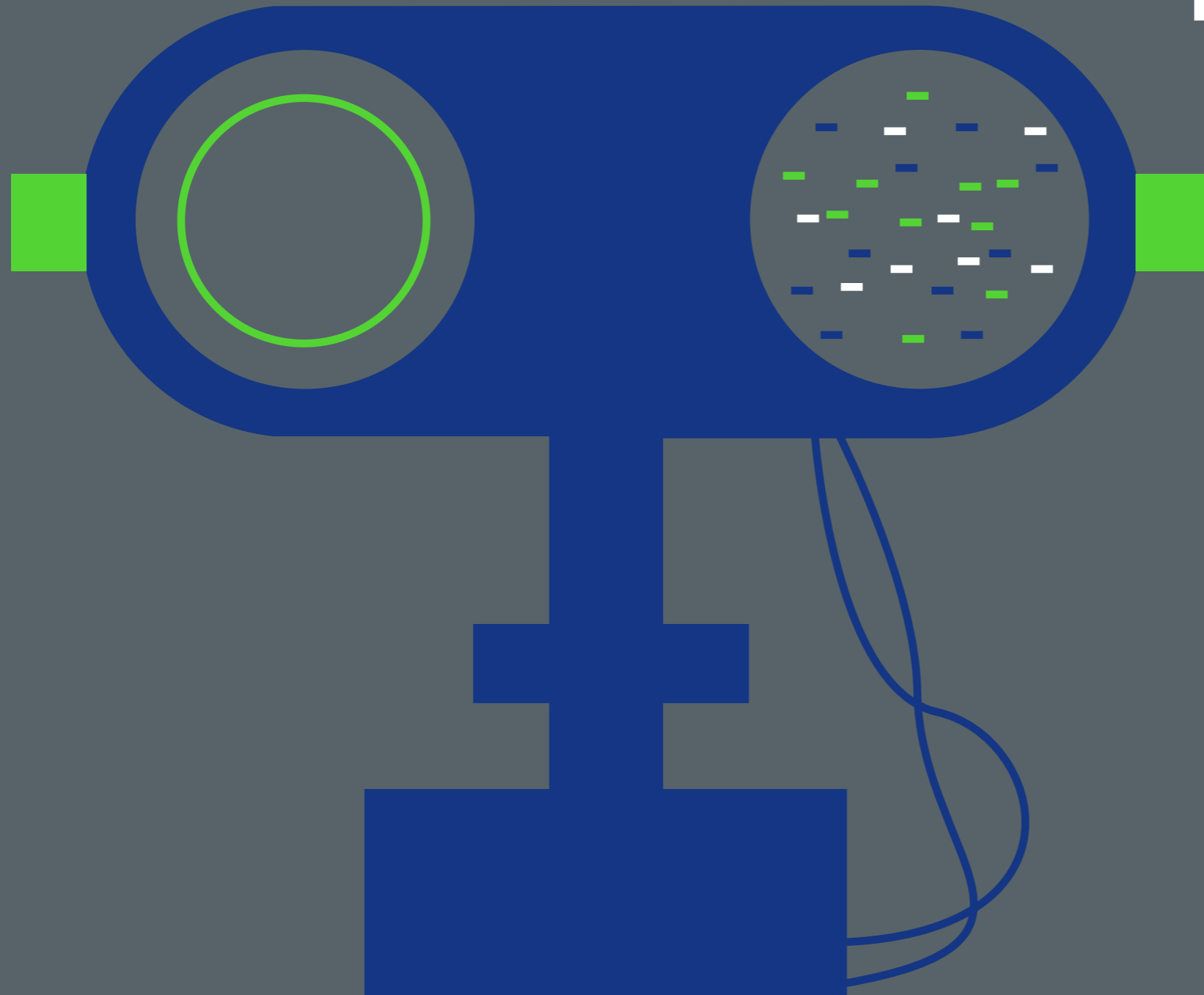
Likewise, average personnel costs per employee in computer programming activities are the lowest in the whole EU.

**AVERAGE PERSONNEL COSTS PER EMPLOYEE, THOUSAND EURO**  
SOURCE: EUROSTAT 2019 FOR 2017

\* Data for 2017 was not available, hence the data for 2016 was used; no data for the Netherlands and Switzerland were available for both 2016 and 2017, hence they are not included



# INDUSTRY 4.0 IN CROATIA





3.1.

## Advanced robotics

Analysis by the Boston Consulting Group found that the use of advanced robots can reduce conversion costs by up to 15%, and combining advanced robotics with other technologies, process enhancements, and structural layout changes can yield savings of up to 40%.

### Success stories

#### GIDEON BROTHERS

URL <https://www.gideonbros.ai/>

Gideon Brothers, a robotics and AI start-up, is one of only three companies globally – and the only one in Europe – developing fully autonomous collaborative mobile robots relying on visual perception, rather than LiDAR sensors, for navigation and safety in industrial environments. Gideon Brothers' vision-based autonomy, which combines stereoscopic cameras and AI, is a breakthrough innovation because

it's more robust and flexible, pushing the boundaries of what a self-driving machine can do in a typical (dynamic) logistics or manufacturing facility. The company's first product is a pallet-carrier, and a range of other products is in development. Its 70-person team includes 9 persons with doctorates and over 40 persons of master's degrees (Nov 2019).

*"When you look at what Gideon Brothers has created globally with mobility, changing technology and expectations, it is quite impressive"*

–  
Dr. Dirk Holbach  
Managing Director,  
Global Supply Chain, Henkel

#### HSTEC

URL <https://www.hstec.hr/en>

HSTec is an innovative development and production company with many years of experience in the field of high-speed motorised spindles, industrial automation and robotics. Product development is based on the principles of open innovation and special prototype production. Of great importance are the continuous improvement and adoption of new technologies and collaboration with scientific research institutions. HSTec offers a wide range of customised motorised spindles, direct driven units, special machine tools and assembly machines, as well as the implementation of robotic cells for various applications. The long-term vision is to contribute to the development of the new concept - Industry 4.0 on a global scale, which aims to create smart products and factories by integrating ICT technology and digitising different sensor systems as a path to improving the quality and efficiency of production processes.

#### H2O-ROBOTICS

URL <https://h2o-robotics.com/>

H2o Robotics is a maritime technologies company specialised in autonomous maritime robotics, underwater

technologies and maritime technologies in general. It has developed H2Omni-X, an autonomous unmanned surface platform specialised for seafloor and surface surveying, mapping and inspection.

### Research facilities

#### INSTITUTE FOR ROBOTICS, ICENT

URL <http://www.icent.hr/en/institute-for-robotics/>

Automation and robotics bring significant innovation potential to technological and social applications. This is why a specialised Institute for robotics was established at the Innovation Centre Nikola Tesla consisting of 5 laboratories:

- Laboratory for Industrial Robotics
- Laboratory for Service Robotics
- Laboratory for Aerial Robotics
- Laboratory for Underwater Robotics
- Laboratory for Autonomous Systems.

#### INSTITUTE FOR ADVANCED COMPONENTS TECHNOLOGIES, ICENT

URL <http://www.icent.hr/en/institute-for-advanced-components-technologies/>

New advanced components are often the backbone of revolutionary technological leaps and numerous innovations, either in terms of miniaturisation, price cuts or entirely new possibilities. Disruptive technologies arising from research and development of advanced components start new trends and create markets. This is why a special Institute for Advanced Components Technologies was established at the Innovation Centre Nikola Tesla consisting of 3 laboratories:

- Laboratory for Optical and Electronic Design
- Laboratory for Nanomaterial and Semiconductor Processing
- Laboratory for Assembly and Qualification

#### LARICS, UNIZG-FER

URL <https://larics.fer.hr/larics>

The Laboratory for Robotics and Intelligent Control Systems (LARICS) is a research laboratory within the University of Zagreb, Faculty of Electrical Engineering and Computing. LARICS research is focused on control, robotics and intelligence in the areas of flying, walking and driving robots, manipulation, warehousing, as well as collective and automotive systems.

#### LAMOR, UNIZG-FER

URL <http://lamor.fer.hr/>

The Laboratory for Autonomous Systems and Mobile Robotics (LAMOR) is a research laboratory at the University of Zagreb, Faculty of Electrical Engineering and Computing. It is involved in research areas covering autonomous systems and mobile robotics, which are focused on mobile robot localisation and modelling of the space in which they perform, detection and tracking of moving objects in the surrounding environment, including mobile robot motion planning and control for task execution.

#### LABUST, UNIZG-FER

URL <http://labust.fer.hr/>

The Laboratory for Underwater Systems and Technologies (LABUST) is a research laboratory at the University of Zagreb, Faculty of Electrical Engineering and Computing. It is engaged in applied research and development of unmanned marine vehicles (underwater and surface), including development and innovation in the field of marine technology.

#### RESEARCH GROUP FOR INTELLIGENT SYSTEMS AND ROBOTICS UNIOS-FERIT

URL <https://www.ferit.unios.hr>

The Research Group for Intelligent Systems and Robotics at the Faculty of Electrical Engineering, Computer Science

and Information Technology, University of Osijek, deals with research in the fields of artificial intelligence, robotics and process automation. Some of the areas in which the group has specific competencies are machine perception or computer vision applicable to the field of robotics and the improvement of the supervisory control system by metric-based learning methods in artificial intelligence. In their work, they also cooperate with companies, like Danieli Automation with which they are working on the development of a computer vision system for industrial robots based on the RGB-D camera, which could be used for various tasks in the metal industry.

**LABORATORY FOR INTELLIGENT PRODUCTION SYSTEMS (LIPS); UNIZG-FSB**

URL <https://www.fsb.unizg.hr/lips/>

The Laboratory for Intelligent Production Systems (LIPS) is a research laboratory within the University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture. The primary expertise of LIPS is in Artificial Intelligence, (Industrial) Robotics and Human-Robot Interaction (HRI) where people and technology occupy the same working environment. LIPS is specially engaged in research areas of autonomous systems combining multimodal interaction, affective (cognitive) robotics, and Mixed Reality (VR and AR).

**AUTOMATION AND ROBOTICS LABORATORY, UNIZG-FSB**

URL <https://www.fsb.hr>

The Automation and Robotics Laboratory is a research laboratory within the University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture. The laboratory is equipped with numerous setups continuously used and providing support to education and research in the fields of robotics

(industrial and mobile robots), hydraulic and pneumatic drives, mechatronics (with a focus on the automotive industry) and control systems.

**LABORATORY FOR AUTOMATION AND ROBOTICS, UNIRI-RITECH**

URL <http://www.riteh.uniri.hr/en/>

The Laboratory for Automation and Robotics is part of Department of Automation and Electronics at the Faculty of Engineering, University of Rijeka. Laboratory work includes regulation of electric motor drives, automation and robotics. The laboratory is an opportunity for scientific and professional cooperation with industries, and a place where projects are implemented.

**LABORATORY FOR INTELLIGENT MACHINE TOOLS AND MACHINING SYSTEMS, UNIRI-RITECH**

URL <http://www.riteh.uniri.hr/en/>

The Laboratory for Intelligent Machine Tools and Machining Systems is a part of Department of Industrial Engineering and Management at the Faculty of Engineering, University of Rijeka. The laboratory carries out scientific and professional activities in the field of machine tools, related equipment (robotics, machine vision) and machining systems to increase the efficiency of production processes by applying advanced methods of modelling, simulation and optimisation. Subsequently, the laboratory has participated in several scientific research projects and has established good cooperation with industry as well as similar laboratories in the surrounding region.

**3.2.**

## Augmented and virtual reality

Virtual and augmented reality will fundamentally alter how we interact with content. The potential applications of these new interfaces are enormous.

### Success stories

**DELTA REALITY**

URL <https://deltareality.com>

Diversitas IT Sustavi d.o.o. and its extended reality (XR) studio, Delta Reality, are experts in the fields of virtual, augmented and mixed reality. With more than ten years' experience in digital realities, the studio creates digital innovations for partners on a global scale, enabling them to improve their promotional, communication, logistical and commercial properties through the use of the latest technologies. The company's products and services are used in 17 countries by brands including Disney, Microsoft, Samsung, Siemens and Deutsche Telekom. This year they have been included in the Deloitte Technology - Fast 50 Central Europe 2019 ranking. Currently, in addition to its day-to-day operations, Diversitas IT sustavi d.o.o. are actively developing

an augmented reality communication tool which will present an entirely new form of communication, following in the footsteps of behemoths like Skype and Whatsapp.

**LEGAME STUDIO**

URL <https://www.legame.hr/>

The company Legame Studio d.o.o. was founded in 2015 with the aim of applying and developing advanced technologies associated with virtual and augmented reality. Legame Studio d.o.o. opened the first virtual reality studio in Croatia. In addition, the company is engaged in developing virtual content - video in 360°, 3D virtual simulations and software solutions for their display.

### Research facilities

**MUEXLAB, UNIZG-FER**

URL <https://muexlab.fer.hr/>

The Multimedia Quality of Experience Research Lab (MUEXlab) is a research lab within the Faculty of Electrical Engineering and Computing, University of Zagreb. The lab conducts multidisciplinary research in the areas of User Experience (UX) and Quality of Experience (QoE) modelling and management of advanced multimedia services, such as multiparty audio-visual communications, video streaming, virtual/augmented reality, and networked games.

**IPG, UNIZG-FER**

URL <http://ipg.fer.hr>

The Image Processing Group (IPG) is a research lab at the Faculty of Electrical Engineering and Computing, University of Zagreb. Lab activities are focused on researching theory and applications involving image processing and computer vision in diverse areas such as processing and analysing images in biomedicine,

visual inspection of product quality for industrial automation, computer vision for advanced driver assistance systems and biometric systems for signature verification.

**HOTLAB, UNIZG-FER**

URL <http://hotlab.fer.hr>

The Human-Oriented Technologies Laboratory is a research lab at the Faculty of Electrical Engineering and Computing, University of Zagreb focused on exploration and development of technological means to analyse and simulate people and their behaviour by blending techniques from various fields, including computer vision, machine learning, computer graphics, virtual and augmented reality, to achieve goals such as face tracking, gaze tracking, performance animation, emotion estimation, gender and age estimation and face-based augmented reality experiences.

**3.3.**

## Internet of Things

The Internet of Things (IoT) embodies the next major economic and societal innovation wave made possible by the Internet in which components, products, services and platforms connect, virtualise and integrate everything in a communication network for digital processing.

### Success stories

**SMART MANUFACTURING**

IoT enables new levels of factory automation for greater efficiency, higher flexibility, agility and lower operational costs.

**ASCALIA**

URL <https://ascalia.io/>

Ascalia is a UK and Croatia based company that provides software and hardware solutions for the digitalisation of manufacturing facilities without high costs or downtime. It is a modern all-in-one platform for IIoT (Industrial IoT) systems, improving productivity and reducing waste in factories using advanced AI-powered systems.

**BYTE LAB**

URL <http://www.byte-lab.com/>

Based in Zagreb, Croatia, Byte Lab has been providing electronic engineering services since 2011. It has successfully completed more than 200 projects all over the world (e.g., their latest work was QUS – the world's first washable smart textile that provides accurate body data capturing). Their specialities are electronic product design, embedded software development and product manufacturing, meaning that they design, test and manufacture while taking into account the specific needs of each client and go from idea to the final product in the shortest possible time.

**VANADO**

URL <https://vanado.hr/en/index>

The company Vanado specialises in the development and implementation of systems for smart production management. Vanado's team consists of mechanical, electrical and computer science engineers, economic experts and graphic designers. Their main product is a smart real-time production management system called PAUK and is directly linked to the warehouse and raw materials. The system combines information, ideas and technology and enables maximum visibility and control of the entire production process in real-time, at any time and from wherever.

### **MOBILISIS**

URL <https://www.mobilisis.com.hr/>

Mobilisis has been on the market for almost 15 years with continuous growth and employment. Mobilisis produces modern and innovative IT infrastructure for industrial process management, as well as mobile data collection and transmission. Mobilisis develops innovative electronic equipment, primarily intended for Industry 4.0 and IoT markets. In 2017, SICK AG completed an equity investment in Mobilisis and became a company shareholder and strategic partner.

### **CULMENA**

URL <https://culmena.hr/en/>

Culmena was established in 2004 and has completed more than 250 successful projects. Utilising digitalization and lean management, it assists companies in becoming more innovative, creative and competitive on the market. Currently, it is implementing the “100 Smart Factories” project, which aims to help companies align with certain requirements of Industry 4.0. This project is designed for small, medium and large manufacturing companies and uses the innovative “Culis” methodology, combining custom made smart solutions, lean tools and green management.

### **SMART FARMING**

Smart farming enables farmers to implement the right cultivation measures, at the right place and the right time. IoT and smart farming applications offer many opportunities for a more sustainable, productive and competitive farming sector.

### **AGRIVI**

URL <https://www.agrivi.com/en/>

The company Agrivi was founded in 2013 by Matija Žulj whose vision was to change the way food is produced. Today, the Agrivi farm management software is globally recognised as one of the top farm management solutions on the market, backed by strong traction from thousands of farmers in over 150 countries worldwide who are able to improve their production with the help of Agrivi.

*“We needed a program that was always available, easy to use and had the capabilities to track all cost applied to our farming operation. Some of the most important activities we track are water usage, machinery cost, and fertiliser.”*

— Brett Rovey, Rovey Dairy, USA, Arizona

### **SMART MOBILITY / AUTOMATED DRIVING**

Connected and automated vehicles have a significant market potential, not only for European vehicle manufacturers and suppliers, but also for the European ICT industry, mobility service providers and SMEs.

### **RIMAC AUTOMOBILI**

URL <https://www.rimac-automobili.com/en/technology/>

Rimac is a technology powerhouse, creating electric hypercars and providing complete technology solutions to global automotive manufacturers. At their Autonomous Driving R&D, the company is working on applying AI to racing and high-performance vehicles, by developing the next generation of software and algorithmic solutions to teach vehicles to perform as well as, and beat racing drivers.

### **VISAGE TECHNOLOGIES**

URL <https://visagetechnologies.com/>

Visage Technologies is a Swedish computer vision company founded in 2002. In 2015, it opened a Croatian subsidiary, and today 78 out of its 79 employees are based in Zagreb. In its Automotive Division, established exclusively for an R&D collaboration project with a major automotive safety supplier, it develops smart algorithms for ADAS (Advanced Driver-Assistance System). By using computer vision to detect and classify objects visible by the vehicle’s camera, they are helping make autonomous driving safer.

### **XYLON**

URL <https://www.logicbricks.com/>

Xylon is an electronics company focused on FPGA designs and owns the logicBRICKS trademark. The company was founded in 1995, and since then has grown into a prominent provider of intellectual property in the fields

of computer vision, image and video processing, networking and embedded graphics. Their mission is to produce optimised IP cores for Xilinx® All Programmable devices and design services which can improve designer effectiveness, assure high-performance Systems on Chip (SoC) designs and lower production costs. The company’s logicBRICKS IP products are widely used in different markets, especially in the automotive market as parts of Advanced Driver Assistance (ADAS) and Automated Driving (AD) products. Xylon also develops and manufactures flexible logiRECORDER automotive data logging solutions for testing and validation of emerging ADAS and AD systems. The company is a Premier Member of the Xilinx Alliance Program and has offices in the EU, USA and Japan.

### **MIKROPROJEKT**

URL <https://www.mikroprojekt.hr/>

Mikroprojekt is an embedded system design house focusing on advanced video and embedded graphics solutions based on FPGAs. They deliver innovative IP, software, and hardware, which offers flexible functionality and high performance in embedded video and graphics systems.

## Research facilities

### **IOT LAB, UNIZG-FER**

[URL http://www.iot.fer.hr/](http://www.iot.fer.hr/)

The Internet of Things Laboratory is a research laboratory belonging to the Faculty of Electrical Engineering and Computing. The laboratory conducts research and innovation activities in the field of the Internet of Things, and aims to develop innovative services, interoperable solutions and software platforms for networking a large number of different devices and encourage multidisciplinary research related to improving living conditions in major cities.

### **IOT LAB, UNIZG-FOI**

[URL https://www.foi.unizg.hr/en/about-us/departments/iot-lab](https://www.foi.unizg.hr/en/about-us/departments/iot-lab)

The IoT Lab at the Faculty of Organisation and Informatics, University of Zagreb, is a place where students and scientists work together on solving IoT related problems. The laboratory provides a testbed and state of the art equipment that is used to create new and interesting products that augment everyday life.

### **RESEARCH GROUP FOR INTELLIGENT VEHICLES, UNIOS-FERIT**

[URL https://www.ferit.unios.hr](https://www.ferit.unios.hr)

The Research Group for Intelligent Vehicles at the Faculty of Electrical Engineering, Computer Science and Information Technology, University of Osijek, researches software development for autonomous vehicles and performs testing according to pre-set standards and methods (AUTOSAR, ISO26262). They also deal with the development of advanced image processing algorithms for automotive cameras used in autonomous driving and with intelligent transport systems (vehicular ad-hoc networks, VANETs), as well as with analysing the operation and topology

of vehicle drives, auxiliary systems and synthesising aimed at optimising energy flow and energy efficiency of vehicles, e.g., through a joint R&D project with the company Rimac Automobili and which focuses on smart load balancing for parallel HV switches in power converters. In 2018, the research group started an initiative to establish a test environment for EV testing in compliance with existing international standards, within which advanced measurement techniques, computer modelling, optimization using advanced soft computing algorithms and simulation based on collected metric sizes EV would be interactively interlinked, and is to be followed by analysis of results for diagnostic purposes the drive element EV, or the predictive EV model.

### **INSTITUTE FOR TRANSPORT SYSTEMS, ICENT**

[URL http://www.icent.hr/en/institute-for-transport-systems/](http://www.icent.hr/en/institute-for-transport-systems/)

The Institute for Transport Systems at the Innovation Centre Nikola Tesla deals with the application of ICT, electrical and mechanical systems on vehicles (automotive, trains and ships), energy efficiency, ecologically acceptable transport, management and monitoring of traffic and multimodal traffic systems and consists of four laboratories:

- Laboratory for Traffic Analysis and Management;
- Laboratory for Integrated Vehicular Systems;
- Laboratory for Drive Systems and
- Laboratory for Energy Converters.

### **ACROSS, UNIZG-FER**

[URL https://across.fer.hr/](https://across.fer.hr/)

The Centre of Research Excellence for Advanced Cooperative Systems (ACROSS) is an interdepartmental research centre at the Faculty of

Electrical Engineering and Computing, University of Zagreb. The centre performs research in cooperative systems related to robotics, networked embedded systems and renewable energy systems.

### **IPG, UNIZG-FER**

[URL http://ipg.fer.hr](http://ipg.fer.hr)

The Image Processing Laboratory (LOS) at the Faculty of Electrical Engineering and Computing, University of Zagreb, is focused on researching theory and applications involving image processing and computer vision in diverse areas such as processing and analysing images in biomedicine, visual inspection of product quality for industrial automation, computer vision for advanced driver assistance systems and biometric systems for signature verification.

### **LABORATORY FOR ARTIFICIAL PERCEPTION AND AUTONOMOUS SYSTEMS, UNIRI-RITECH**

[URL http://www.ritech.uniri.hr/en/](http://www.ritech.uniri.hr/en/)

APASLab is a study and research group at the Department of Computer Engineering at the Faculty of Engineering, University of Rijeka. The laboratory focuses on study and research in the fields of mobile robotics, depth imaging and human-machine interaction.

### **TRAFFIC AND LOGISTICS DATA SCIENCE LAB**

Ericsson Nikola Tesla and the Faculty of Transport and Traffic Science, University of Zagreb, recently established a new joint Traffic and Logistics Data Science Lab. The joint laboratory was established due to the increasing importance of applying data science in modern-day traffic and logistics. As a cooperation initiative, Ericsson Nikola Tesla will lead processes related to data gathering, pre-processing, processing and visualisation while Faculty employees will analyse

acquired traffic and logistics data and investigate opportunities for applying such data.



3.4.

## Artificial Intelligence/Big data

Artificial Intelligence (AI) isn't something new. However, until recently, the lack of data mired its growth. Today, there is an enormous amount of data available of all types and predictive algorithms, the result of data mining. Big data will become the basis for various uses of AI.

### Success stories

#### MICROBLINK

URL <https://microblink.com>

Microblink is an R&D company developing AI-powered solutions for computer vision and intelligent data extraction. Microblink simplifies data entry in mobile and web apps using camera input. In adopting advanced

machine learning techniques, we develop state of the art products that link the physical world to modern apps.

#### AETHER SIGNUM

URL <https://www.aether-signum.hr/>

Aether Signum's primary focus is modern computer vision and machine learning technology. They do R&D for any required target project, and their solutions range from automated industrial solutions and stand-alone surveillance systems to sports data extraction and mobile apps.

#### AMODO

URL <https://www.amodo.eu/>

Through the customer engagement system and combined analytics technology, the Amodo platform enables insurance companies, digital brokers and adjacent industries to market new products and services and engage users through smartphones. Amodo has been listed in the Financial Times Special Report – FT Intelligent Business 2019 as one of the five global disruptors who are using big data and telematics to transform the insurance industry.

#### VINGD

URL <https://www.vingd.ai/>

Vingd is building emotionally intelligent AI assistants employed in organisations like hospitals, banks, telecoms and retailers to manage relationships with their clients at scale.

#### 3TOPIA

URL [www.3topia.agency](http://www.3topia.agency)

3topia designs and develops mobile and web apps, as well as enterprise solutions with a preference for those requiring AI features, or requiring them in the future. Their development process and results have been recognised by many international and domestic clients - leaders in different fields, such as the University of Oxford, Computer Science

Department (built a product based on their cybersecurity research and 3topia's expertise in Computer Vision and quality software development) or the German company Zizoo.

#### EXALTUM

URL [www.exaltum.eu](http://www.exaltum.eu)

Exaltum is an R&D intensive company dealing with big data in life sciences. They provide standard as well as custom-tailored solutions employing advanced machine learning methods for analysis of genetic data, aimed at extracting maximum knowledge from the raw sequencing (long- and short-reads) and other -omics datasets: gene panels, whole exome and whole genome sequencing, assembly and variant calling, transcriptome and ChIP-Seq quantitative analysis, chromatin structure mapping and metagenomic profiling. They cater to a wide range of clients from academic institutions to medical sector entities and the pharmaceutical industry.

## Research facilities

#### CENTRE FOR ARTIFICIAL INTELLIGENCE, UNIZG-FER

URL <https://cai.fer.hr/en/cai>

The Centre for Artificial Intelligence of the Faculty of Electrical Engineering and Computing, University of Zagreb, was established in October 2019 and is the largest research centre in the area of artificial intelligence in Croatia bringing together more than 100 researchers (faculty and doctoral students) from 18 research laboratories at the Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia.

#### HPC ARCHITECTURE AND APPLICATION RESEARCH CENTER, UNIZG-FER

URL <https://hpc.fer.hr/en/hpc>

The HPC Research Centre of the Faculty of Electrical Engineering and Computing, University of Zagreb, is focused on the design of high-performance, energy-efficient, application-specific computing systems. Throughout our research activities, we address the hot-topic challenges for both: embedded and HPC systems such as energy efficiency, architectural and algorithmic optimisations of compute-intensive applications.

#### AI LAB, UNIZG-FOI

URL <http://ai.foi.hr/>

The Artificial Intelligence Laboratory of the Faculty of Organisation and Informatics, University of Zagreb, conducts cutting-edge, long-term research and education in artificial intelligence, multi-agent systems, computational intelligence, web mining, semantic web and related topics.

#### LABORATORY FOR DATA TECHNOLOGIES, UNIZG-FOI

URL <http://datalab.foi.hr/>

The Laboratory for Data Technologies of the Faculty of Organisation and Informatics, University of Zagreb, performs theoretical and practical research in the fields of data and knowledge management (data collecting, storage, querying, analysis, presentation, visualisation, sharing) while taking into account different challenges posed by big data and unstructured data.

#### LABORATORY FOR GENERATIVE PROGRAMMING AND MACHINE LEARNING, UNIZG-FOI

URL <https://gpml.foi.hr/laboratory/index.php?id=about-us>

The Laboratory for Generative Programming and Machine Learning at the Faculty of Organisation and

Informatics, University of Zagreb, researches Generative Programming and Machine Learning, as well as implementing projects and building appropriate software.

**RESEARCH GROUP FOR HIGH-PERFORMANCE COMPUTING AND DATA ANALYSIS; UNIOS-FERIT**

URL <https://www.ferit.unios.hr>

The Research Group for High-Performance Computing and Data Analysis at the Faculty of Electrical Engineering, Computer Science and Information Technology, University of Osijek, aims to make research results applicable in the field of data collection and storage, through analysis by using complex procedures of computer intelligence and machine learning (for the web, mobile and service environments and real-time data analysis) as well as parallel and distributed data processing in energy-efficient, high-performance computer systems. The main fields of application are biomedicine and medical services, mobility and transportation system, agriculture, food industry, smart and energy-efficient environment, scientific computing, cybersecurity, business computer systems and data centres of companies and institutions, e.g., through the R&D project together with the company Trilix and with the goal of building a mobility network based on beacons and supported by the big data analysis and machine learning approaches.

**LABORATORY FOR MACHINE LEARNING AND KNOWLEDGE REPRESENTATION, DIVISION OF ELECTRONICS, RBI**

URL <https://www.irb.hr/>

Research at the Laboratory of Machine Learning and Knowledge Representation at the Ruđer Bošković Institute places its focus on developing new algorithms,

techniques and methodologies in the realm of machine learning and data mining, and is capable of solving contemporary knowledge discovery problems in other, data-driven domains of science. Methods for data exploration and visualisation, learning efficient data representations for predictive and interpretable modelling of data, are the long-term research interest of the laboratory. Part of the research activities are related to the development of unsupervised, a.k.a. data-driven, algorithms for solving fundamental problems such as data clustering, feature selection and denoising. Development of algorithms involves advanced optimisation methods and multilinear representations for both shallow and deep learning models. These methods are applied for solving real-world problems such as segmentation and denoising of medical images in radiology (PET/CT), pathology (microscopic images) and ophthalmology (OCT) with the aim of computer-aided diagnosis of diseases. Another application domain is related to the field of metabolomics and aims to identify small organic molecules, a.k.a. metabolites, incorporated in biochemical reactions to pathophysiological stimuli. Other important application areas of newly developed methods include computational biology, genomics, drug discovery, and modelling of complex systems and networks.

**LABORATORY FOR INFORMATION AND SIGNAL PROCESSING, DIVISION OF ELECTRONICS, RBI**

<https://www.irb.hr/>

The emphasis of the scientific work taking place in the Laboratory for Information and Signal Processing at the Ruđer Bošković Institute is on development of fundamental methods and principles, through

multidisciplinarity and an integrated engineering approach by which signal and data processing is a key technology in scientific and technical application. The research is based on theoretical and experimental investigation, covering all phases of the measurement and analysis processes. Research is focused on improving the performance and security of digital systems based on new architectures, advanced algorithms and reprogrammable technologies. Research in the field of deterministic algorithms with applications in bioinformatics and data storage compression and retrieval. Applications include processing of DNA reads in compact space and linear time. Research in the AI field is focused on text processing with applications in automatic analysis of texts, such as computer-assisted agenda detection.

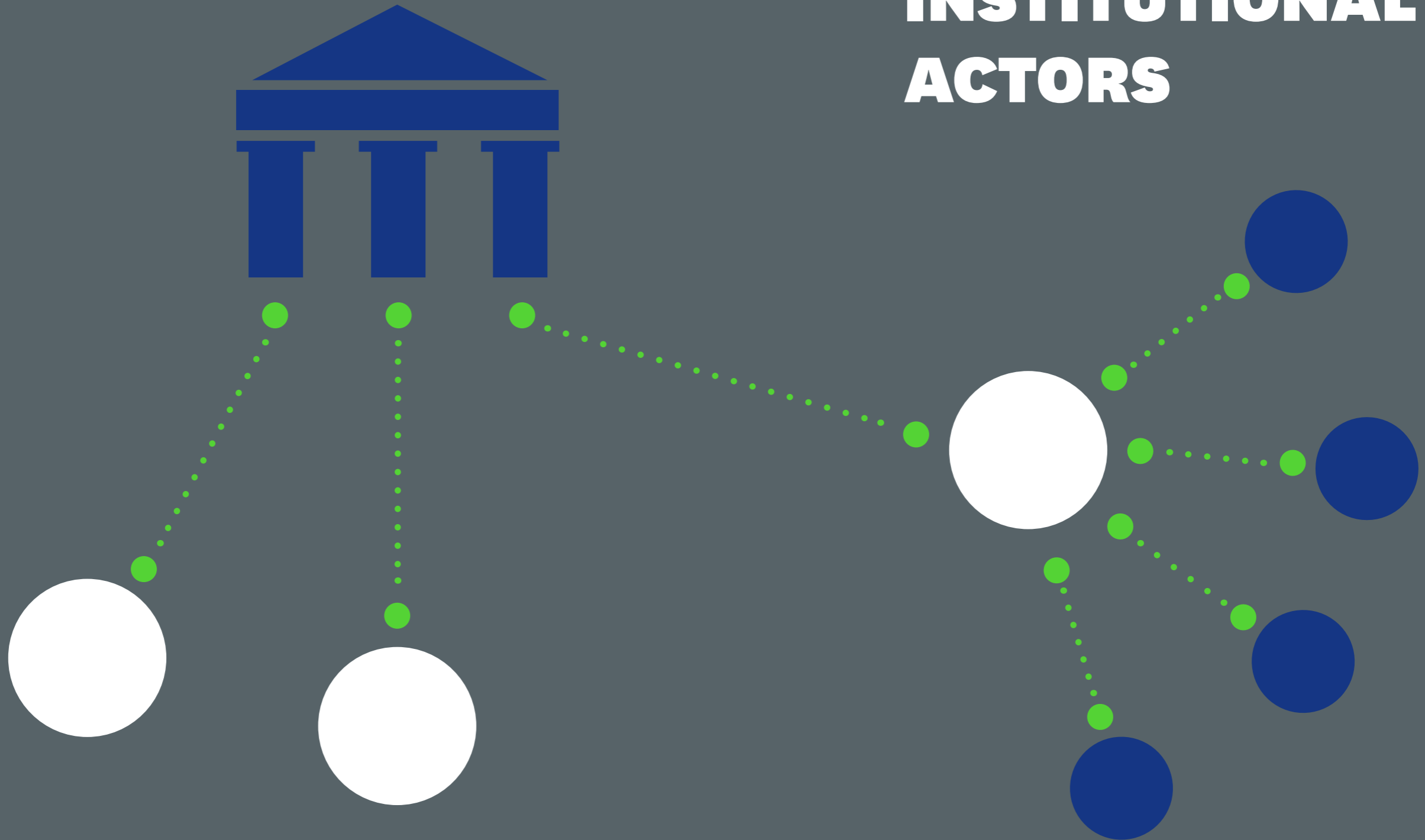
**ALGEBRA LAB**

URL <https://www.algebra.hr/lab/en>

As a part of the Algebra Group, Algebra LAB provides professional consulting support and develops practical, applicable digital solutions for higher standards in service delivery in the private and public sector. Algebra LAB's key-experts are especially strong in the areas of data-driven economy and big-data solutions, ranging from the predictive analysis of the labour market to smart transportation systems, churn management models, customer lifetime management models, cost allocation and management systems, advanced visualisation and data science/big data architecture services. Areas of expertise include labour market analysis, VET implementation, NSI support (dissemination databases, advanced visualisation and data monetisation scenarios), while clients range from domestic to international, from SMEs to corporations, including governments and governmental institutions. Algebra LAB offers educational modules and incubation programs for entrepreneurs and start-up projects (over 70 start-ups have gone through the LAB start-up program) as well as R&D opportunities for investors from the private and the public sector.



# INSTITUTIONAL ACTORS

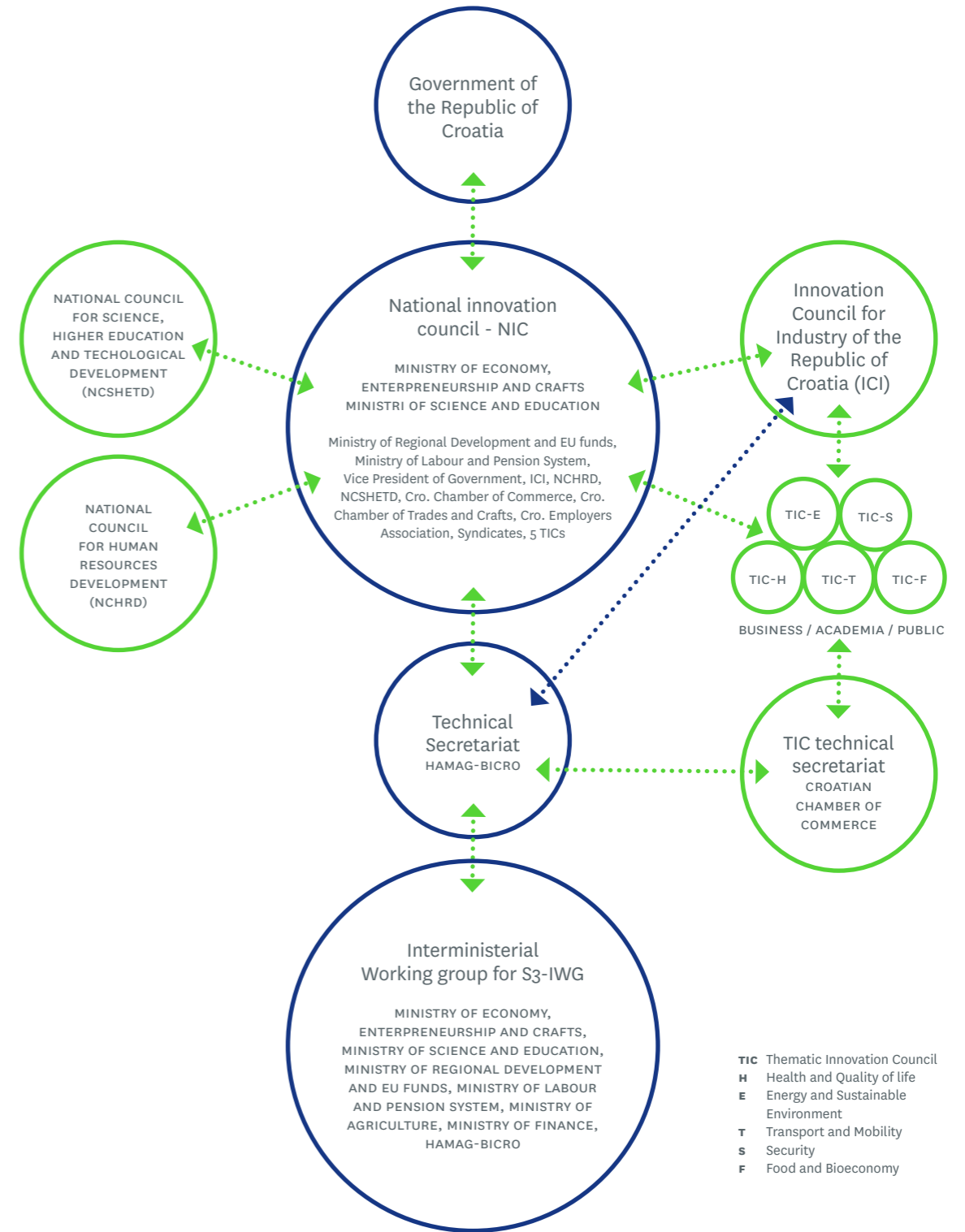


4.1

## Croatia's innovation governance system

The configuration of the Croatian institutions in charge of governing science, technology and innovation is similar to governance structures of most of the EU countries. It is based on active cooperation between the Croatian Government, academia and the industry. At the forefront, is the Nation Innovation Council established in 2018, chaired consecutively by the Minister of Economy, Entrepreneurship

and Crafts and the Minister of Science and Education with its three advisory bodies; National Council for Science, Higher Education and Technological Development, Innovation Council for Industry of the Republic of Croatia and the National Council for the Human Resources Development.



#### 4.2.

## Faculty of Electrical Engineering and Computing, University of Zagreb

URL [https://www.fer.unizg.hr/en/faculty\\_research](https://www.fer.unizg.hr/en/faculty_research)

The Faculty of Electrical Engineering and Computing (FER) is one of the leading research institutions in Croatia.

At the moment, around one hundred research projects are being carried out at FER, as well as dozens of cooperation projects in collaboration with the economic sector.

FER has 34 research laboratories and 5 research centres.

The research and innovation activities at FER are divided into the following activity clusters:

- Health - Tools, Technologies and Digital Solutions for Health and Care; Health Care Systems.
- Inclusive and Secure Society - Democracy; Cultural Heritage; Social and Economic Transformations; Disaster-resilient Societies; Protection and Security; Cybersecurity.
- Digital and Industry - Manufacturing Technologies; Key Digital Technologies; Advanced Materials;

Artificial Intelligence and Robotics; Next Generation Internet; Advanced Computing and Big Data; Low-Carbon and Clean Industries; Space.

- Climate, Energy and Mobility - Energy Supply; Energy Systems and Grids; Buildings and Industrial Facilities in Energy Transition; Communities and Cities; Industrial Competitiveness Transport; Clean Transport and Mobility; Smart Mobility; Energy Storage.
- Food and Natural Resources - Environmental Observation; Agriculture, Forestry and Rural Areas; Sea and Oceans; Bio-based Innovation Systems; Circular Systems.

### INNOVATION CENTRE NIKOLA TESLA (ICENT)

URL <http://www.icent.hr/en/about-us/>

ICENT is a non-profit institution established by the FER to enable and accelerate efficient commercialisation of new technologies in the areas of energetics, transport, automation and robotics, advanced components, biomedical engineering and information and communication technologies. ICENT integrates applied research and development, innovation and commercial processes for setting up new industrial technologies, products, services and business models. It consists of six institutes:

- Institute for information and communication technologies,
- Institute for Power Engineering,
- Institute for Transport Systems,
- Institute for Robotics,
- Institute for Biomedical Engineering and
- Institute for Advanced Components Technologies.

#### 4.3.

## Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb

URL [https://www.fsb.unizg.hr/index.php?fsbonline\\_en&lang=en](https://www.fsb.unizg.hr/index.php?fsbonline_en&lang=en)

The Faculty of Mechanical Engineering and Naval Architecture (FAMENA) is one of the top Croatian institutions in education, science and expertise in the fields of mechanical engineering and naval architecture, and for the last two decades in the field of aeronautical engineering too.

### REGIONAL CENTER OF EXCELLENCE FOR ROBOTIC TECHNOLOGY

URL <https://100.fsb.hr/en/118/Regional+Center+of+Excellence+for+Robotic+Technology>

In 2020, the Regional Centre of Excellence for Robotics will be established at the Faculty of Mechanical Engineering and Naval Architecture as a reference centre for research, development and education in the field of robotics and artificial intelligence. The activities of the Centre will be directed towards the research and development of advanced robotics applications in industry and medicine.

#### 4.4.

### Faculty of Science, University of Zagreb

URL <https://www.pmf.unizg.hr/en>

The Faculty of Science includes seven departments: Department of Physics, Department of Mathematics, Department of Geophysics, Department of Chemistry, Department of Geology, Department of Biology and Department of Geography.

All the academic staff are actively involved in research carried out at high international standards across the whole spectrum of scientific activities ranging from basic to applied research, and many have been recognised internationally for their contributions to research and development. The Faculty is especially proud of continuous cooperation with internationally recognised research institutions, such as

CERN, on developing new technologies such as GEM detector technology which resulted in the founding of the spin-off company Picologic for producing floating multi-channel picoammeters.

The Faculty conducts projects and has experience in a vast area of research that includes i) climate change and global warming ii) renewable energy resources iii) seismic hazard and risk iv) the earth's magnetic field v) the Adriatic Sea vi) waste disposal and pollution control vii) quantitative systems-level analyses of biological processes viii) development of software tools for bioinformatics ix) design and synthesis of new functional materials including nanomaterials x) study of novel materials in the class of strongly correlated systems (quantum magnetism, superconductors, multiferroics...) xi) thermodynamics and kinetics of chemical and biochemical processes (xii) development of chemical computational approaches (xiii) qualitative and quantitative chemical analysis and process analytical tools (xiv) structure and function of biomolecules and biosystems xv) basic and applied ecology xvi) phylogenetic and phylogeographic analyses xvii) biomedical applications xviii) data and computer science xix) modeling quantum and complex physical systems, and xx) geospatial technologies.

There are three additional centres within the Faculty of Science, i.e., the Centre of Excellence in Chemistry (CIuK), Centre for Advanced Research of Complex Systems (CeNIKS) and Centre of Excellence for Quantum and Complex Systems, and Representations of Lie Algebras (QuantiXLie).

#### 4.5.

### Faculty of Organization and Informatics, University of Zagreb

URL <https://www.foi.unizg.hr>

The Faculty of Organization and Informatics (FOI), located in the City of Varaždin, provides education to future experts in the field of information sciences and technologies, economics, organisation, communication and other related fields.

FOI has a long tradition of collaborating with the industry and especially in fostering start-up companies within the premises of the Technology Park Varaždin which was established by the Faculty of Organization and Informatics, the City of Varaždin and University North in Varaždin.

The Faculty experts have vast project and research experience within the following

areas: application of information and communication technologies, management of information systems, re-engineering of business processes, e-government, decision support systems, e-learning, e-schools, strategic planning, standardization, methodology and repositories, electronic and mobile business, XML frameworks of interoperability, software engineering, methodology of the development of information systems, quantitative methods of decision-making, risk analysis and project management, strategic planning of information systems, Internet of Things, E-portfolios, and Entrepreneurship. The faculty is especially proud of fostering activities among underrepresented groups in ICT.



4.6.

## Faculty of Electrical Engineering, Computer Science and Information Technology, University of Osijek

URL <https://www.ferit.unios.hr/home>

The Faculty of Electrical Engineering, Computer Science and Information Technology in Osijek is a modern faculty that has been continuously developing in all areas of its expertise.

The educational process consists of three levels with study programmes being continually upgraded and harmonised with recent scientific discoveries, economy and labour market needs. The faculty's research groups have participated in numerous domestic and European projects as either heads or associates and the faculty successfully cooperates with the most important electrical engineering and ICT companies.

The perfect example of successful cooperation with partner companies is the master's (graduate) study programme in Automotive Computing and Communications (AutoCom). Namely, the first initiative related to the AutoCom study programme started in 2016 with the companies RT-RK Osijek and Rimac Automobili. Upon defining the basic structure of the AutoCom study programme, other companies were invited as well to participate in defining the study programme in January 2017. Four companies, namely Yazaki, AVL AST, Xylon and GlobalLogic joined. Currently, a similar programme for Industry 4.0 is being developed.

4.7.

## Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split

URL <https://eng.fesb.unist.hr/faculty/about/>

With approximately 2500 students and more than 250 employees, the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture (FESB) has grown into recognised and highly respectable educational and research institution dealing with the advanced technologies and,

consequently, contributing to the development of the economy and society.

In particular, the robustness of FESB research capabilities has been confirmed through numerous successful competitive and other research and technological projects, the number of scientific and professional papers published in peer-review journals, and through the continuous cooperation with internationally recognised research and academic institutions, such as CERN, TECHNION, PENN STATE and with extensive research collaborations (MAGIC, CMS, ITER and ALICE).

It has 148 teaching personnel and 95 laboratories.

Given its significant research potential in the area of engineering and natural sciences, the Faculty founded its strategic programme of scientific research on long term experience and in accordance with the relevant strategic documents, principally EUROPA 2020, a strategy for smart, sustainable and inclusive growth and the Smart Specialisation Strategy of the Republic of Croatia. Following the strategic aims defined in those documents, the Faculty has established priorities in research related to energy sources (with an emphasis on renewable energy sources, especially solar and wind energy), energy efficiency and environmental issues, information and communication technologies, biomedical engineering, machine engineering, basic engineering sciences and naval architecture.

The Faculty has placed focus on scientific research with topics, programme and research goals: Energy efficiency and renewable energy sources; Development of the modular design concept of the hybrid module for power production by integration of photovoltaic systems and mini wind generators; Advanced numerical modelling of electromagnetic phenomena in electric power systems; Smart grid metrology infrastructure; Power electronics converters in renewable energy systems; Development of innovative smart factory; Design of advanced multi-purpose vessels; Research in the field of new information and communication technologies including wireless communications, advanced network technologies, cloud computing, communication between machines and humans and security aspects; Application of information and communication technologies in environment protection and forecasting, control and disaster risk management; Research in the field of electromagnetism applied to: wireless communications, electromagnetic compatibility, bio-electromagnetism, new and renewable energy sources and energy transfer; Research into new and renewable energy sources and related information and communication technologies and systems; Smart environment; Advanced operations management and their application in the management of complex systems; Energy efficiency in buildings, Renewable energy sources, Fuel cells and hydrogen technologies; Design of power transmissions with independently controllable output speed; Development of adaptive parameterization for optimisation and meshless methods in dynamics; Modeling and optimisation of machining processes; Development of innovative methodology of numerical-experimental evaluation of energy efficiency of

construction systems of passive and active building envelopes; and Health and support to human activities, i.e., biomedical engineering, development of knowledge-based systems, information and communication systems, processing of large data sets and technologies for better teaching and learning.

4.8.

## Faculty of Engineering, University of Rijeka

URL <http://www.riteh.uniri.hr/en/>

The Faculty of Engineering was established in the year 1960. The Faculty encompasses 11 departments which include 38 sections and 50 laboratories, as well as the Computing Centre.

The Faculty of Engineering has about 2200 students and 179 employees, of which approximately 3/4 are teaching and 1/4 administrative staff. The Faculty of Engineering of the University of Rijeka conducts scientific, developmental and professional research, especially programs of strategic interest for the region in which it operates for the Republic of Croatia as a whole, and undergraduate, graduate and postgraduate education. The Faculty cooperates actively with academic (scientific and higher education) and economic partners at home and abroad. The Faculty provides opportunities for internal and external mobility of its students and teachers, the rational use of human and material resources,

the development of multidisciplinary scientific-teaching activities, and the supervision and continuous growth of quality, competitiveness and international competitiveness of teaching, scientific and professional work.

4.9.

## Algebra

URL <https://www.algebra.hr/en>

The Algebra Group is the biggest private education provider in the region and the leader in digital higher education, adult learning, training and certification programs in Croatia, present in all major Croatian cities.

More than 15,000 students attend Algebra's programmes annually under the guidance of more than 600 experts and lecturers. In 2014, Algebra was voted by Microsoft as their best learning partner in the world, from 3,200 competing organisations. Due to strong quality assurance standards, the Algebra University College (AUC) has constantly been rated as the best professional study programme in the Republic of Croatia. In 2019 Algebra signed a cooperation agreement with the Institute Ruđer Bošković to facilitate learning and research programmes in the HPC area. The Algebra HPC Academy is the first step in that direction.

4.10.

## Ruđer Bošković Institute

URL <https://www.irb.hr/>

The Ruđer Bošković Institute is the largest Croatian scientific research centre of a multidisciplinary character.

It participates in numerous internationally and nationally financed, and international peer-reviewed scientific projects, such as those within the framework of the program Horizon 2020, programs from the IAEA, FP7, Croatian Science Foundation (HrZZ), NATO, NSF, ICGEB and projects of other foreign scientific foundations. The Institute is currently engaged in over 200 projects. With a capacity of six per cent of the total number of scientists in Croatia, which the Ruđer Bošković Institute employs, this Croatian institute has pulled over from this program 57 per cent of total funds raised by all scientific institutions in Croatia, enhancing its position as a strategic Government partner in engaging EU funds.



4.11.

## Centres of Research Excellence

URL <https://www.zci.hr/en/>

Centres of Research Excellence gather and crosslink the best scientists in a particular field at a national level that are focused on contemporary research topics.

Research organizations or their organizational parts or groups of scientists are declared a Centre of Research Excellence by the Minister of Science, at the proposal of the National Council for Science, Higher Education and Technology Development, and based on an evaluation made in compliance with the law that regulates quality assurance in science and higher education and a procedure which must include international assessment.

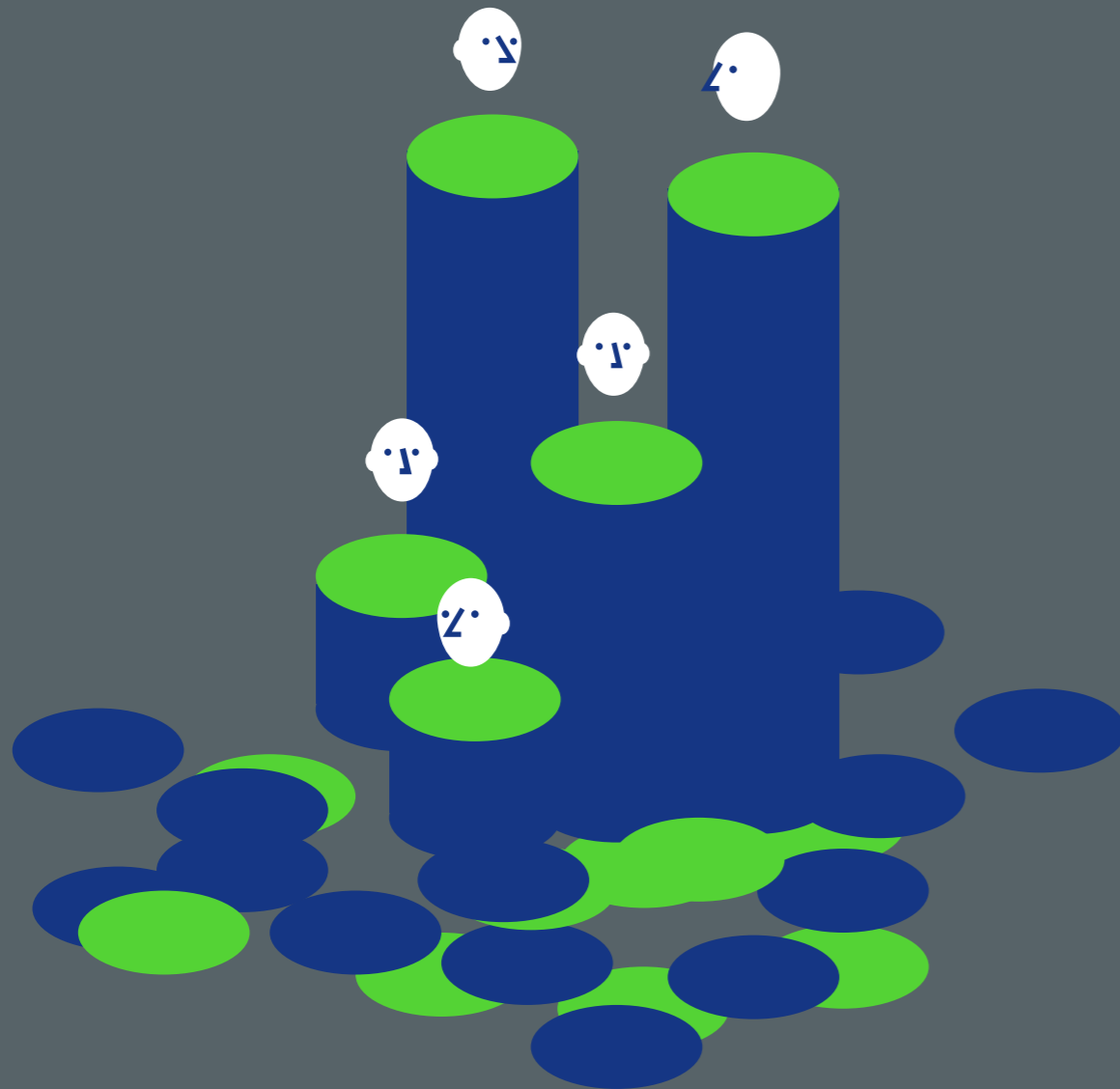
There are currently 13 Centres of Research Excellence:

NO.	FIELD OF SCIENCE	TITLE OF THE CORE	RESEARCH UNIT	HOST INSTITUTION	LINK
1.	Natural sciences	CoRE for Advanced Materials and Sensing Devices – CEMS	New Functional Materials	Ruđer Bošković Institute	<a href="http://cems.zci.hr/">http://cems.zci.hr/</a>
			Science on Graphene and Related 2D Structures	Institute of Physics	
			Photonics and Quantum Optics	Ruđer Bošković Institute	
			Ion beam physics and technology	Ruđer Bošković Institute	
2.		CoRE for Science and Technology (STIM)	/	University of Split - ICAST	<a href="http://stim.zci.hr/">http://stim.zci.hr/</a>
3.		CoRE for Quantum and Complex Systems and Representation of Lie Algebras	Research in Quantum and Complex Systems - QuantiX	University of Zagreb, Faculty of Natural Sciences and Mathematics	<a href="http://quantixlie.zci.hr/">http://quantixlie.zci.hr/</a>
			Research in Number Theory, and Related Structures	University of Zagreb, Faculty of Natural Sciences and Mathematics	

NO.	FIELD OF SCIENCE	TITLE OF THE CORE	RESEARCH UNIT	HOST INSTITUTION	LINK
4.	Biomedicine	CoRE for Reproductive and Regenerative Medicine	Biomedical Research of Reproduction and Development	University of Zagreb School of Medicine	<a href="http://cerrm.mef.hr/hr/">http://cerrm.mef.hr/hr/</a>
			Regenerative Medicine	University of Zagreb School of Medicine	
			CoRE for Research in Viral Immunology and the Development of New Vaccines	Faculty of Medicine of the University of Rijeka	
5.		CoRE for basic, clinical and translational neuroscience	/	University of Zagreb School of Medicine	/
6.		CoRE for Integrative Bioethics	/	Faculty of Humanities and Social Sciences, University of Zagreb	<a href="http://www.bioetika.hr/">http://www.bioetika.hr/</a>
7.	Humanities	CoRE for Croatian Glagolism	/	Old Church Slavonic Institute	<a href="http://hg.zci.hr/">http://hg.zci.hr/</a>
8.	Social sciences	CoRE for School Effectiveness and Management	/	University of Zagreb Faculty of Economics and Business	<a href="http://zci-sem.zci.hr/">http://zci-sem.zci.hr/</a>
9.		CoRE for Biodiversity and Molecular Plant Breeding	/	University of Zagreb Faculty of Agriculture	<a href="http://biodiv.zci.hr/">http://biodiv.zci.hr/</a>
10.	Biotechnical sciences	CoRE for Marine Bioprospecting - BioProCro	/	Ruđer Bošković Institute	<a href="http://BioProCro.zci.hr/">http://BioProCro.zci.hr/</a>
11.	Interdisciplinary- biotechnical sciences and biomedicine	CoRE for Personalised Health Care	Research in Glycoscience	University of Zagreb Faculty of Pharmacy of Biochemistry	/
			Production and Medical Research on Functional Food	Josip Juraj Strossmayer University of Osijek	
12.	Technical sciences	CoRE for Data Science and Cooperative Systems	Research in Data Science	University of Zagreb Faculty of Electrical Engineering and Computing	<a href="http://across-datascience.zci.hr/">http://across-datascience.zci.hr/</a>
			Research in Advanced Cooperative Systems (ACROSS)	University of Zagreb Faculty of Electrical Engineering and Computing	

# ACCESS TO FINANCE

The Government of the Republic of Croatia offers numerous financial programmes and incentives in this field. According to the Digital Economy and Society Index 2019, the Government Budget Allocation for R&D (GBARD) in ICT is higher than the EU average.



## 5.1.

# R&D Incentives

URL <http://investcroatia.gov.hr/en/incentives/measures-to-promote-research-and-development/>

State aid for research and development projects is regulated by the Act on State Aid for Research and Development Projects effective from 26 July 2018. The state aid provider is the Ministry of Economy, Entrepreneurship and Crafts, while the implementing body is the Croatian Agency for SMEs, Innovations and Investments (HAMAG-BICRO).

Beneficiaries are legal and natural persons, corporate or personal income taxpayers which deal with basic research, industrial research and experimental development or feasibility studies for the R&D project.

State aid consists of tax relief (income tax base reduction) as follows:

RESEARCH CATEGORY	BASIC INTENSITY SUPPORT (OF ACCEPTABLE EXPENSES)	ADDITIONAL REDUCTION OF TAX BASE	MAXIMUM SUPPORT (€)	INCREASE OF MAXIMUM SUPPORT AMOUNT* (€)
BASIC	100%	200%	300.000	40 M
INDUSTRIAL	50%	150%	200.000	20 M
EXPERIMENTAL DEVELOPMENT	25%	125%	100.000	15 M
FEASIBILITY STUDY	50%	150%	50.000	7,5 M

The project implementation period is up to three years from the beginning of the project.

\* if more than 50% of the cost of conducted research is based on contracts, knowledge, and patents obtained or licensed by the other parties under market conditions, and the costs of consultancy and similar services provided solely for the project are contracted with organisations for research and dissemination of knowledge

## 5.2.

# Investment incentives

URL <http://investcroatia.gov.hr/en/incentives/incentive-measures-for-investment-projects/>

Incentive measures for investment projects in the Republic of Croatia are regulated by the Act on Investment Promotion and pertain to investment projects in:

- manufacturing and processing activities,
- development and innovation activities,
- business support activities,
- high value-added activities.

Incentive measures can be used by enterprises registered in the Republic of Croatia investing in fixed assets the minimum amount of:

- EUR 50,000 in addition to creating at least three new jobs for microenterprises,
- EUR 150,000 in addition to creating at least five new jobs for small, medium-sized and large enterprises,
- EUR 50,000 in addition to creating at least ten new jobs for ICT system and software development centres.

The amount of aid shall be calculated as the percentage of investment value, which is determined based on eligible investment costs. Maximum aid intensity depends on the category of the enterprise.

Classification of enterprises is performed in accordance with Annex I of Commission Regulation (EU) N°651/2014 of 17 June 2014:

ENTERPRISE CATEGORY*	STAFF HEADCOUNT*	AND	ANNUAL TURNOVER*	OR	ANNUAL BALANCE SHEET TOTAL*	MAXIMUM AID INTENSITY (OF ACCEPTABLE EXPENSES)
LARGE	> 250		> 50 million €		> 43 million €	25%
MEDIUM-SIZED	< 250		≤ 50 million €		≤ 43 million €	35%
SMALL	< 50		≤ 10 million €		≤ 10 million €	45%
MICRO	< 10		≤ 2 million €		≤ 2 million €	45%

\* When calculating staff headcount and financial amounts, one also has to take into account partner enterprises and affiliated enterprises as prescribed in Annex I of Commission Regulation (EU) N°651/2014 of 17 June 2014

Types of investment incentives provided by the Act are:

- profit tax rate deduction/abolishment for up to 10 years
- up to € 13,500 for every new employee in development and innovation activities
- up to 70% of eligible costs of education and training
- up to € 0.5 M for the purchase of machinery for development and innovation activities
- up to € 1 M for eligible costs of investments in long-term assets

An enterprise intending to acquire the status of a beneficiary of incentive measures must complete an application to receive incentives using the prescribed forms and lodge it to the Ministry of Economy, Entrepreneurship and Crafts before commencing the investment.



### 5.3.

## Croatian Agency for SMEs, Innovations and Investments

URL <http://www.investcroatia.hr/>

The Croatian Agency for SMEs, Innovations and Investments (HAMAG-BICRO) was founded by the Republic of Croatia with the aim of supporting the development of small and medium-sized enterprises, improving innovation processes and encouraging investments.

### Guarantees

HAMAG-BICRO provides guarantees to small and medium enterprises (SMEs). Guarantees are issued for loans approved by credit institutions and other legal entities approving loans to SMEs. Currently, HAMAG-BICRO offers three different guarantee programs approved by the Croatian Government.

### ESIF GUARANTEES

#### INDIVIDUAL

Financial Instruments under ESIF (European Structural and Investment Funds) for individual guarantees are intended for SMEs and are largely financed from funds from the European Regional Development Fund. Under this financial instrument, HAMAG-BICRO provides to SMEs, through financial institutions, a guarantee for coverage of part of the loan principal or lease. The guarantee amount ranges from the minimum € 150,000.00 to the maximum amount of € 1,000,000.00 (for working capital), or € 2,000,000.00 (for investments). The maximum guarantee rate is 65% of the principal loan amount (for working capital) or 80% of the principal loan amount (for investments). A risk premium from 0.25% to 1% of the guarantee amount is paid.

#### LIMITED PORTFOLIO GUARANTEE

Financial Instruments under ESIF (European Structural and Investment Funds) for Limited Portfolio Guarantees are intended for SMEs. The financial institution pursues a portfolio of loans or leases to SMEs, while HAMAG-BICRO covers part of the principal and interest on part of the loans or leases included in the portfolio by issuing guarantees through the signing of the Cooperation Agreement. The maximum guarantee amount is € 150,000. The maximum guarantee rate is 80% of the principal loan amount. Both investment loans and working capital loans are included. There is no risk premium.

#### NATIONAL GUARANTEES

#### PLUS

The Program aims to facilitate access to financing for micro, small and medium-sized businesses investing in eligible activities. Guarantees are provided both

for investments and working capital, as well as for the purchase of business shares. The maximum guarantee amount is € 1,000,000.00 or up to 50% of the principal of the refinancing loan. For the purchase of business shares, the maximum guarantee amount is € 50,000.00 or 80% of the loan principal (for micro-entities) and € 2,000,000.00 or 60% of the loan principal (for small and medium-sized entities).

### Loans

HAMAG-BICRO also provides loans.

#### ESIF LOANS

This financial instrument is intended for SMEs, including natural persons who, at the time of applying for a loan, do not have their own registered economic entity but plan to establish one which will have the status of micro, small or medium-sized business entity.

#### SMALL LOANS FOR INVESTMENTS

The loan amount ranges from € 25,000.01 to € 50,000.00 with the interest rate varying from 0.5% to 1.5%, depending on the place of investment. The maximum repayment period is 10 years, including the grace period. No approval fee is charged.

#### MICRO LOANS FOR INVESTMENTS

The loan amount ranges from € 1,000 to € 25,000 with the interest rate varying from 0.5% to 1.5%, depending on the place of investment. The maximum repayment period is 5 years, including the grace period. No approval fee is charged.

#### MICRO LOANS FOR WORKING CAPITAL

The loan amount ranges from € 1,000 to € 25,000 with the interest rate varying from 1.5% to 3.5%, depending on the

place of investment. The maximum repayment period is 3 years, including the grace period. No approval fee is charged.

### Grant schemes

#### INNOVATION VOUCHERS (ESI FUNDS)

The call is implemented in the form of vouchers and aims at strengthening SME capacities for collaboration with higher education institutions and research organisations. The grant value ranges from € 1,300 to € 10,000.

The call was published on 21 May 2018 and is open until June 2020.

#### INNOVATION FOR NEWLY ESTABLISHED SMES - PHASE II

The call "Innovation for Newly Established SMEs - Phase II" is aimed at newly established micro, small and medium-sized enterprises and aims to provide support for successfully launching innovative products and services with growing potential and which are new to the market, in addition to focusing on radical innovation and significant improvement in product commercialisation and services. Eligible applicants are SMEs not older than 36 months. The grant value ranges from € 20,000 to € 186,000. The call was published on 15 February 2019 and is open until 29 June 2020.

#### SUPPORT TO DEVELOPMENT OF NEW PRODUCTS/SERVICES RESULTING FROM R&D ACTIVITIES - PHASE II (ESI FUNDS)

The call aims to support the development of new products (goods and services), technology and business processes by increasing private investment in research, development and innovation, and strengthening the enterprise's capacity for research, development and innovation while

improving their cooperation with research and development institutions. Eligible applicants are enterprises (both as applicants and partners) and research organisations (as partners). The call for proposals is in the announcement phase and its release is expected by the end of 2019.

#### **INTEGRATOR**

The call aims to encourage cooperation from SMEs to create supplier relationships with integrator companies and become part of their value chain by providing new innovative products and services. Eligible applicants are SMEs. The call for proposals is in the announcement and its release is expected by the end of 2019.

#### **EUREKA**

EUREKA Network Projects are market-driven innovative R&D projects, devised and run by an international consortium. The funding and support are provided through the national innovation agencies and public administrations that make up the Eureka network. The grant value is € 200,000 (60% for micro and small, 50% for medium-sized enterprises, and 40% for large enterprises).

Next call for project proposals will be in 2Q of 2020.

#### **EUROSTARS**

Eurostars supports innovative international projects led by research and development-performing SMEs (R&D-performing SMEs). It is a joint programme between EUREKA and the European Commission, co-funded from the national budgets of 36 Eurostars Participating States and Partner Countries and by the European Union through Horizon 2020. The grant value is € 200,000 (60% for micro and small, 50% for medium-sized enterprises).

The next call for project proposals will be in February 2020.

#### **PROOF OF CONCEPT**

PoC provides support to beneficiaries in proving their concepts, allowing them to bridge the financing gap, to deal with technology risk and providing further assistance on their way to commercialisation. Eligible activities are TRL 3-4 (functional prototype, technical demonstration, IP check and protection) with additional eligible activities consisting of Market Analysis or Feasibility Study and Commercialisation plan.

The next call for project proposals will be in Q2 of 2020.

#### **5.4.**

## **Croatian Bank for Reconstruction and Development (HBOR)**

**URL** <https://www.hbor.hr/en/>

### **The Croatian Bank for Reconstruction and Development (HBOR) was established on 12 June 1992 by the Act on the Croatian Credit Bank for Reconstruction.**

Within the Croatian banking system, HBOR plays the role of a development and export bank established with the objective of financing the reconstruction and development of the Croatian economy. HBOR was founded and is entirely owned by the Republic of Croatia.

## **Loans**

#### **PRIVATE SECTOR INVESTMENT**

**URL** [https://www.hbor.hr/en/kreditni\\_program/private-sector-investment/](https://www.hbor.hr/en/kreditni_program/private-sector-investment/)

Private sector business entities – companies, crafts businesses, sole traders, family farms, cooperatives and institutions can receive loans for investments in fixed assets (tangible and intangible assets) for the purpose

of business modernisation, introduction of new technologies, increasing existing capacities, investments in research and development and the introduction of new products or services, promotion of environmental protection, energy efficiency and renewable energy resources projects, tourist capacities and facilities as well as encouraging new employment. Financing through the loan can be up to 75% of the estimated investment value, VAT is not included. Interest rates vary from 1.30% p.a. fixed to 3% p.a. fixed with a repayment period of up to 17 years.

#### **EU PROJECTS**

**URL** [https://www.hbor.hr/en/kreditni\\_program/eu-projects/](https://www.hbor.hr/en/kreditni_program/eu-projects/)

Private and public sector business entities can receive loans for both eligible expenses – project expenses to be financed from grant proceeds and ineligible expenses – expenses that cannot be financed from grant proceeds (fixed assets and working capital up to 30% of the contracted loan amount) from European Structural and Investment Funds (ESI Funds) or EU Agricultural and Fisheries Funds. The loan amount varies from 75% to 100% of the estimated investment value. Interest rates vary from 1.70% p.a. fixed to 1.90% p.a. fixed with a repayment period of up to 17 years.

#### **ESIF GROWTH AND EXPANSION**

**URL** [https://www.hbor.hr/en/kreditni\\_program/esif-growth-and-expansion/](https://www.hbor.hr/en/kreditni_program/esif-growth-and-expansion/)

Small and medium-sized enterprises that have been operating in the territory of the Republic of Croatia for at least two years before the submission of loan application, meet all eligibility criteria and plan to invest in eligible sectors can receive loans for new investment in fixed assets, long-term tangible and intangible assets and working capital. The loan is funded from proceeds provided by ESIF and commercial banks at a

50:50 ratio and can amount to € 3 M or in the case of the tourism industry, up to € 10 M. The interest rate is 0% on the part of loan principal from ESIF funds, while on the part of loan principal from commercial bank's funds, it is calculated in accordance with the commercial bank's business decision. Loans are approved with a repayment period of up to 17 years and no customary banking fees charged.

## Investment Programmes

### **CROGIP**

**URL** [https://www.eif.org/what\\_we\\_do/resources/croatian-growth-investment-programme/index.htm](https://www.eif.org/what_we_do/resources/croatian-growth-investment-programme/index.htm)

The Croatian Growth Investment Programme (CROGIP) is a € 70 million equity investment programme launched in January 2019. The funds are to be invested alongside private investors and will support Croatian SMEs, small midcaps and midcaps' access to growth and expansion equity capital. EIF and HBOR have contributed € 35 million each to this jointly developed programme, which is expected to catalyse additional private-sector investments into funds and companies.

### **FRC2**

**URL** <https://www.hbor.hr/frc2-croatia-partners/>

Frc2 Croatia Partners SCSp is a venture capital fund financed partly from ESIF Financial Instruments through cooperation with the European Investment Fund. The Fund is managed by FRC2 GP S.à r.l. and consists of two components: an accelerator programme dedicated to innovative start-ups that have only a business idea (Start-up School) or prototype (Accelerator), and equity investments (VCs) intended for start-up and first-time-to-early-stage enterprises.

### **5.5.**

## **Horizon 2020**

**The biggest EU Research and Innovation Programme (Horizon 2020) with € 78 billion for the period 2014-2020 which provides funding for applicants from the private and public sector in almost all areas of science and technology.**

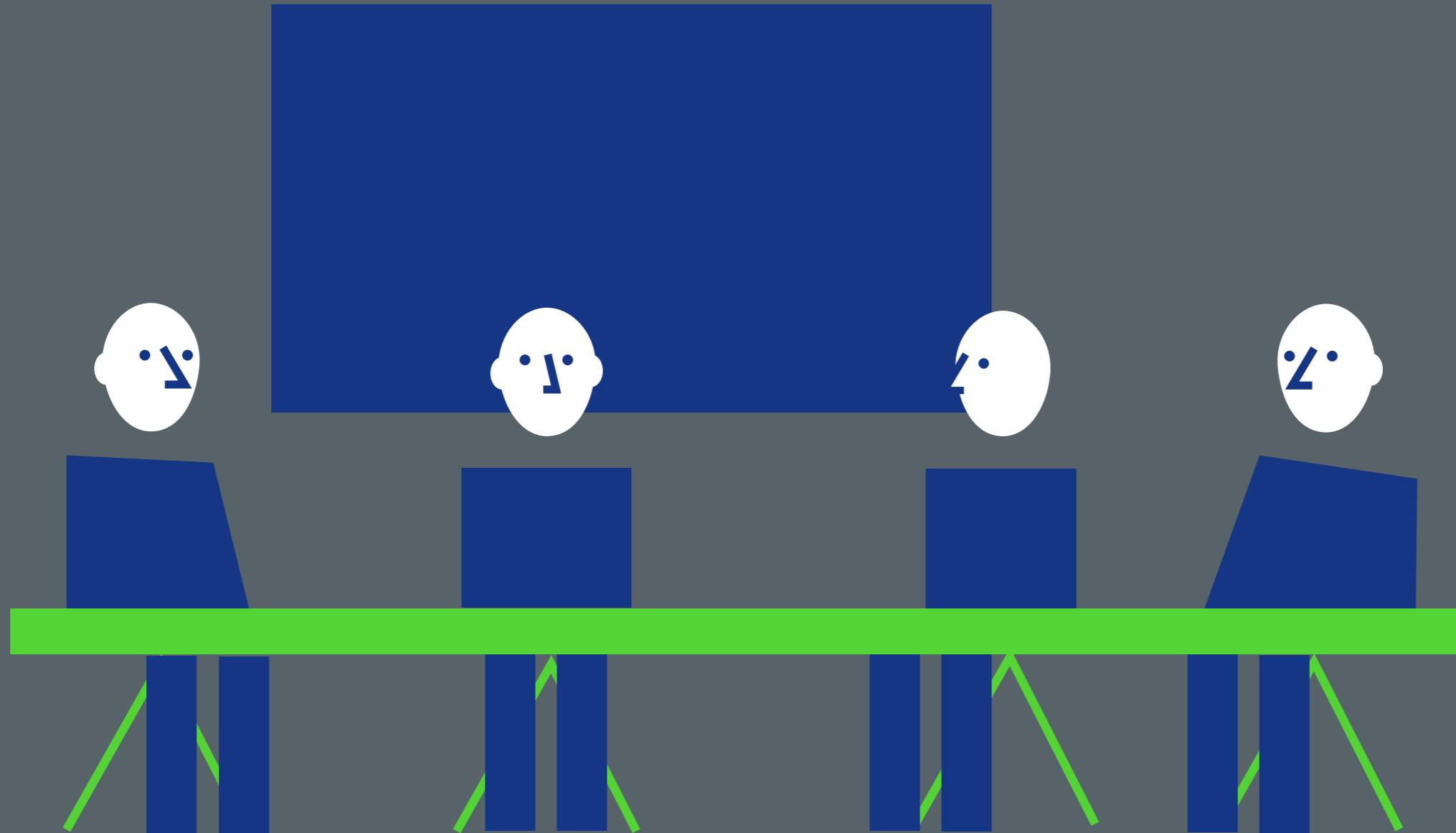
Most of the activities are within the Programme's finance consortium projects but there are also options for individual applicants, for instance, ERC grants for investigator-driven frontier research and EIC accelerator for SMEs. There are several areas of Horizon 2020 supporting Industry 4.0 projects including Information and Communication Technologies (ICT), Future and Emerging Technologies (FET), Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing and Biotechnologies (NMPB) and Research Infrastructures (e-infrastructure).

Open or announced calls for specific topics within these areas can be found at the dedicated European Commission web portal (<https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/h2020>).

On the national level, support for this Union Programme is provided by national contact persons (NCP) for specific areas of Horizon 2020: <http://www.obzor2020.hr/obzor2020-kontakt>.

The Croatian Ministry of Science and Education offers small grants to support Horizon 2020 applicants. These measures include support for attending international meetings, brokerage events and other activities to meet suitable project partners and educational and advisory services for successful application and management of Horizon 2020 projects. Measures also include support for applicants who have achieved at least 70% of total points in the evaluation process, but have not been funded by the European Commission. The public call is continuously open for Horizon 2020 applicants from the public sector, NGOs and SMEs on the MSE website (<https://mzo.gov.hr/vijesti/dopune-mjera-potpore-za-povecanje-prijava-na-program-obzor-2020-i-promociju-inicijativa-vezanih-uz-svemir-i-svemirske-tehnologije/2054>). Information is also available via e-mail [O2020\\_mjere\\_2018@mzo.hr](mailto:O2020_mjere_2018@mzo.hr).

# INSTITUTIONAL SUPPORT





## The Ministry of Economy, Entrepreneurship and Crafts

URL <http://investcroatia.gov.hr/en/>

The Ministry of Economy, Entrepreneurship and Crafts represents a focal point for investors in the Republic of Croatia. It provides support during the implementation of the investment projects by:

- Offering all necessary information relevant to investments in Croatia, such as analyses of the business climate and investment framework, investment opportunities (projects, business zones, etc.), investments incentives, etc.
- Professional and tailor-made assistance throughout all stages of the investment process,
- Organising visits to investments sites and arranging meetings with public and private bodies,
- Promoting Croatia as a business and investment destination through specific seminars and conferences on investment opportunities in Croatia, promotional materials and cooperation with partner institutions on the domestic and international market.



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