

CXI TUL





Foto: Zuzana Bajtová (Fotobanka TUL)



Welcome!

CXI TUL

CXI TUL



The Institute for Nanomaterials, Advanced Technologies and Innovations (CXI) is a research center of the Technical University of Liberec (TUL). Our goal is to contribute to the development of a region traditionally oriented towards technical industries.



A total of **11** departments focus on solving questions not only in the macro world but also in a world a million times smaller than a millimetre, in which different physical rules apply. The one called the nanoworld.



Every year, around **80** research projects employ more than **170** scientific, technical and administrative staff. Students also cooperate on research projects here.





HISTORY OF CXI



The Institute was established within the OP RDI project "Center for Nanomaterials, Advanced Technologies and Innovations" as one of the first centers of this type in the Czech Republic. The CXI building was opened in the year **2012**.

In the years 2009 - 2013, a highly sophisticated university research center was built with an emphasis on the applicability of research and development results in practice.

The project supported TUL's long-term activities in the field of industrial innovation with qualified personnel and state-of-the-art equipment.



PERSONNEL STRUCTURE

to December 31, 2024



CXI has more than **170 employees** (23 of whom are foreigners):

- *supervisors and independent researchers (C3 and C4)*
 - *senior researchers (C2)*
 - *junior researchers (C1)*
 - *technicians / lab assistants*
 - *administrative support*
- 98
- 69

The average age is approximately 41 years. 49% of CXI employees are women, 29% of women work in managerial positions.

CXI collaborates across the university and also provides facilities for students.



RESEARCH DIRECTIONS



Nanomaterials in natural sciences focus on the R&D, synthesis, behavioral description, and particularly application of advanced materials and nanomaterials, mostly in the field of water treatment, environmental protection and life sciences. This research direction ensures that the innovations contribute to a sustainable and healthier world.



Competitive engineering focuses on the research, development, and application of cutting-edge engineering technologies and structures. We specialize in mechatronic systems, power units, and other machine and vehicle components in view of new approaches. We also excel in progressive methods for processing new materials, including additive technologies. Our innovative solutions are designed to drive progress and efficiency across various industries.



System integration deals with the development of state-of-the-art SW solutions, data processing and integration between systems, cybersecurity and architecture, communication protocols such as 5G, providing communication interfaces for industrial applications. Our expertise covers sensors and electronics, PLCs, robotics, including the use of collaborative robots, cloud application development, big data analytics, machine learning and AI, LLMs, industrial computer vision and others.



RESEARCH DIRECTIONS - COMPETENCES



Autonomous systems

autonomous and cooperative systems
autonomous utility electrovehicle

Additive manufacturing

3D printing including metallic prints and reinforcing by advanced materials

Green technologies, up-scaling

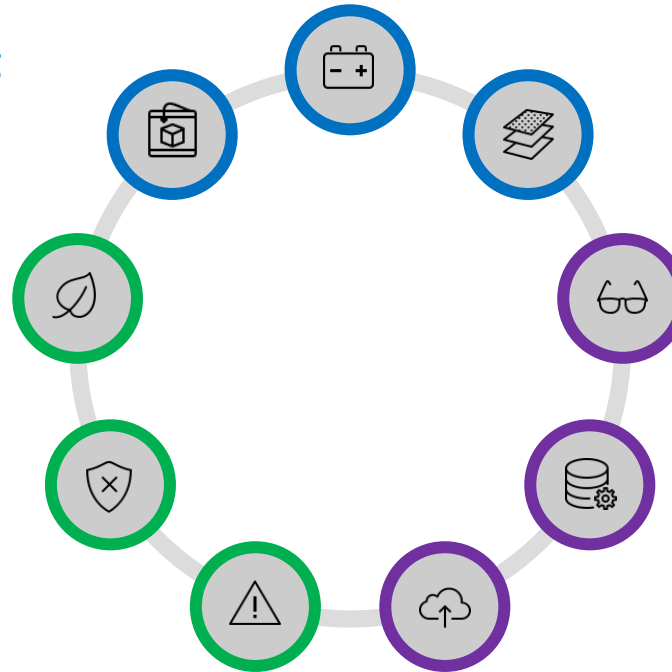
environmental friendly products,
piloting of technologies

Environmental protection

(waste) water and groundwater
treatment, waste disposal, air
filtration

Risk of nanomaterials, high-tech analysis

environmental risk of nanomaterials,
advanced analytical techniques



Advanced materials and machines design

the new light-weight and sustainable components,
innovative design and systematic planning of
technical systems innovations

Augmented reality

collaboration & remote assistance, mixed
reality wearables

BIG DATA, artificial intelligence

big data storage and analysis, machine
learning & AI, image and pattern recognition

Industrial IoT

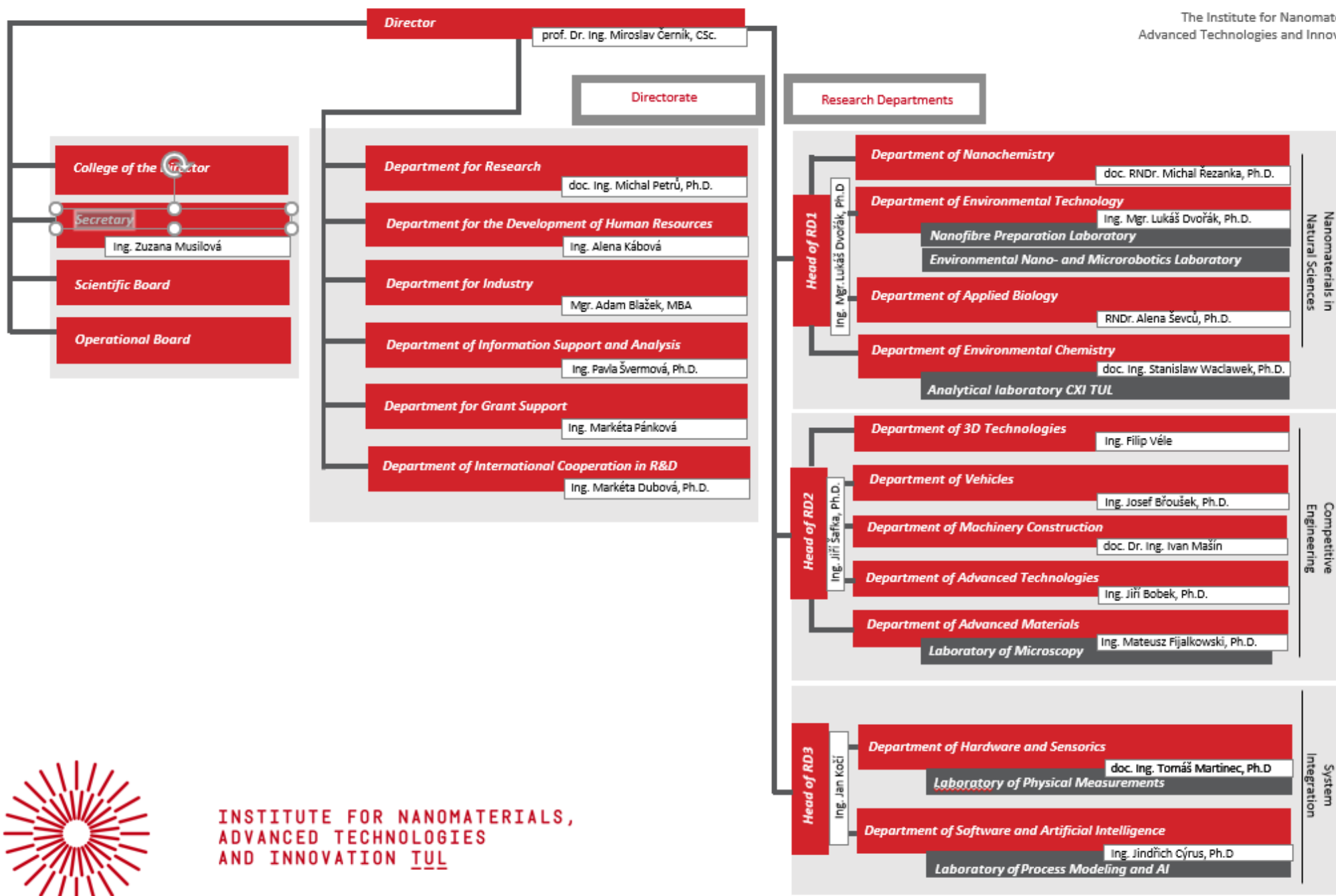
advanced sensors, displays, edge and cloud
computing, 5G and SigFox networks





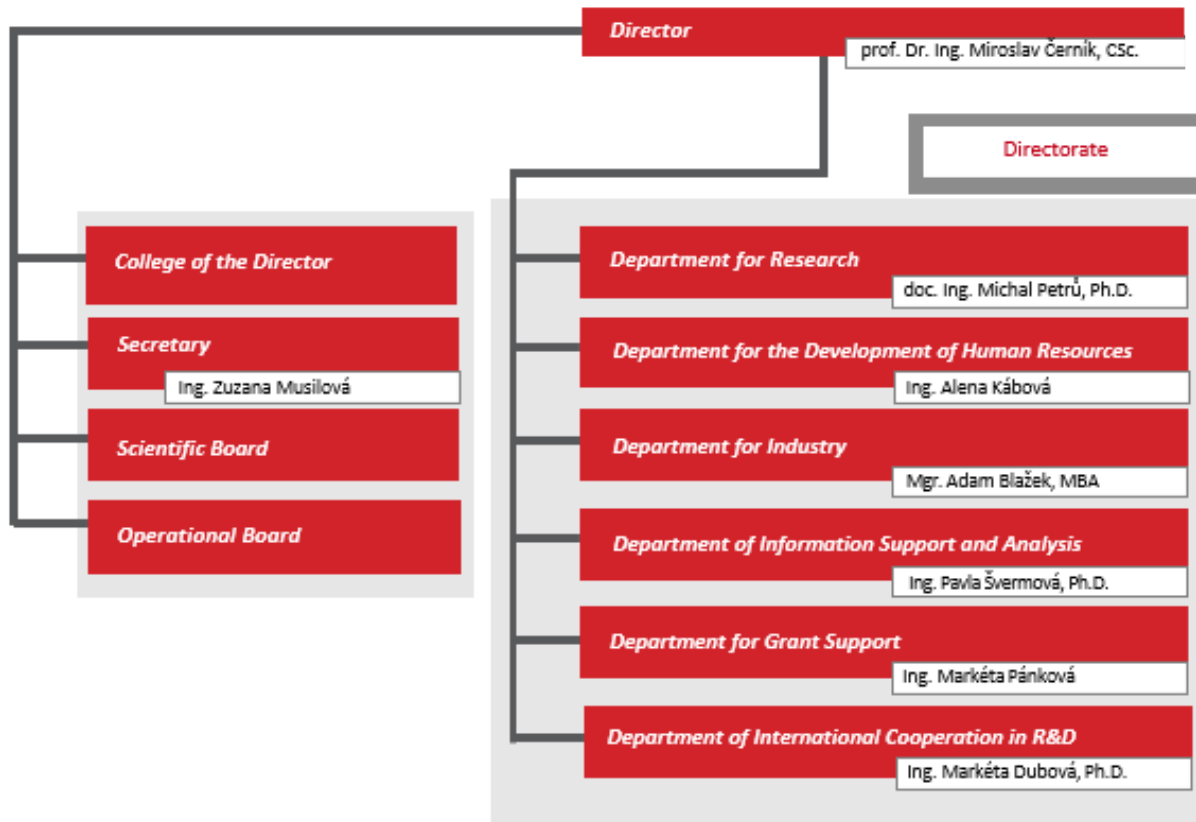
Organizational structure and human resources







Ing. Z. Musilová
CXI TUL Secretary



prof. Miroslav Černík, CSc.
CXI TUL Director



doc. Ing. M. Petruž
R&D



Ing. A. Kábová
HR



Mgr. A. Blažek, MBA
Industry



Ing. P. Švermová, Ph.D.
IT Support and Analysis



Ing. M. Pánková
Grant Support

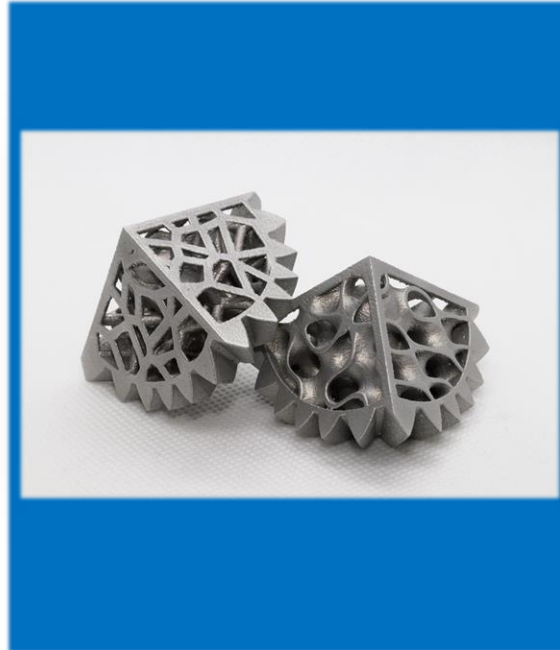


Ing. M. Dubová, Ph.D.
International Cooperation

CXI RESEARCH DIRECTIONS



**Nanomaterials in
natural sciences**



**Competitive
engineering**



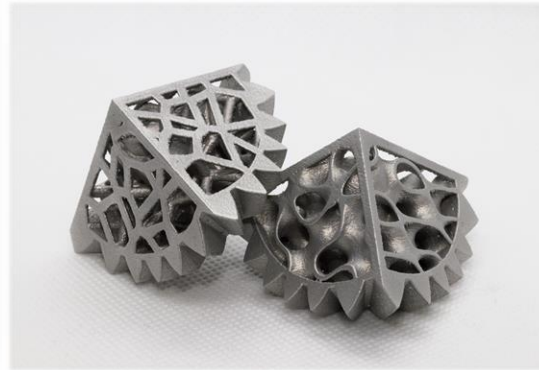
System integration



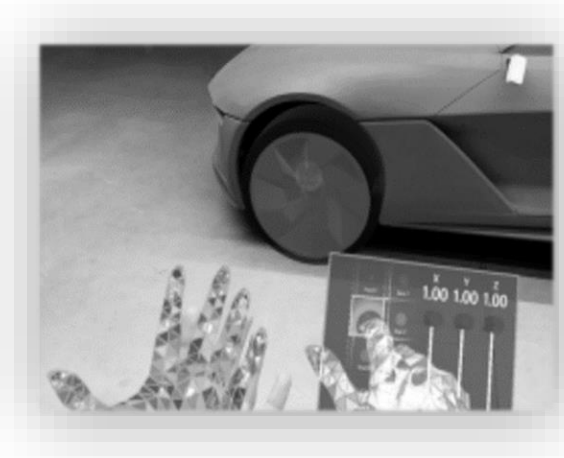
CXI RESEARCH DIRECTIONS



**Nanomaterials in
natural sciences**



**Competitive
engineering**



System integration



RESEARCH DIRECTION NO. 1



**Nanomaterials in
natural sciences**

- Study and application of advanced materials, especially nanomaterials, especially in the fields of environmental protection and safety, biotechnology and life sciences, including hi-tech analytical techniques
- The research direction combines basic research with applied research and development of advanced technologies and structures not only based on nanomaterials but also includes pilot projects in the field of technologies at real workplaces in close cooperation with industries



NANOMATERIALS IN NATURAL SCIENCES



DEPARTMENT
OF NANO CHEMISTRY

DEPARTMENT OF
ENVIRONMENTAL TECHNOLOGY

DEPARTMENT
OF APPLIED BIOLOGY

DEPARTMENT OF
ENVIRONMENTAL CHEMISTRY

The research direction of **nanomaterials in natural sciences** combines basic and applied research, advanced technologies including hi-tech analysis, not only environmental contaminants. Great emphasis is also put on synthesis and testing of different nanomaterials and their verification in practical application, mainly in water treatment processes.



DEPARTMENT OF ENVIRONMENTAL TECHNOLOGY



MAIN RESEARCH ACTIVITIES

- Advanced (waste)water treatment technologies
- Membrane bioreactors and systems with biomass carriers
- Effective groundwater remediation by nano- and microiron
- Application of nanomaterials in various treatment processes and technologies
- Development and testing of nano-based filters

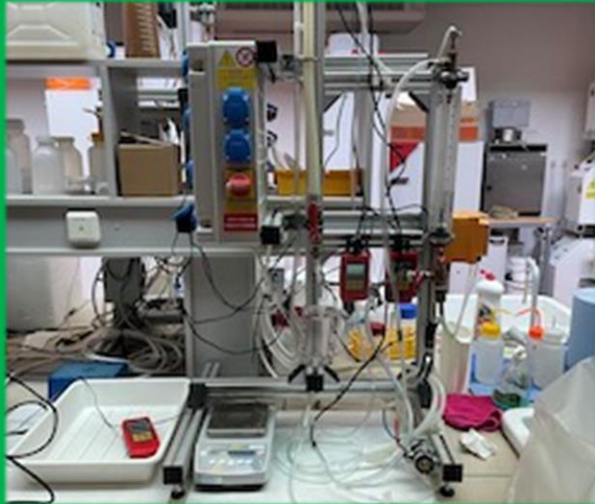
COOPERATION

- Project and contracted R&D in cooperation with industrial partners and stakeholders
- Taylor-made research and development
- Examination and intensification of current treatment processes
- Independent expert evaluation

Ing. Mgr. Lukáš Dvořák, Ph.D.
Head of OTŽP



DEPARTMENT OF ENVIRONMENTAL TECHNOLOGY



Environmental Nanorobotics Laboratory (LEN)

M. Pumera

- Development and study of microrobots and nanomaterials for applications in environmental protection
- Use advanced techniques for synthesising autonomously moving colloidal nanoparticles, nanorobots and microrobots that can be programmed for specific tasks, etc.

Nanofibre Preparation Laboratory (LPN)

M. Komárek

- Preparation of flat nanofibrous layers by electrostatic wetting of polymer solutions
- Optimization of the preparation process by setting and on-line control of parameters (especially electrical voltage, currents, speed, temperature and humidity) in the softening room
- Modification of material parameters of nanofibre layers
- Preparation of composite fibres with nanofibre cladding



DEPARTMENT OF ENVIRONMENTAL CHEMISTRY



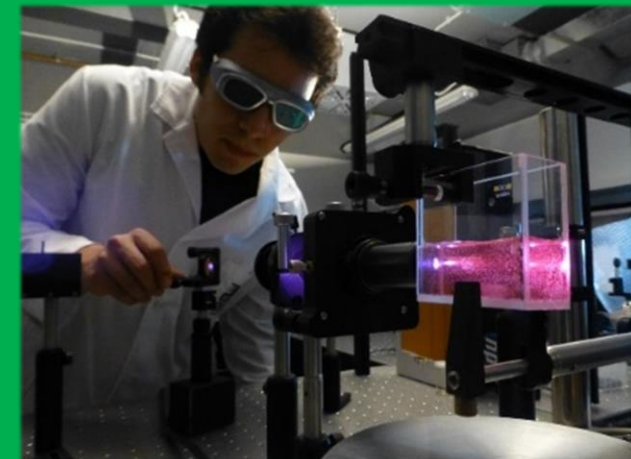
MAIN RESEARCH ACTIVITIES

- Toxic substances in the environment - advanced methods of their monitoring and catalytic elimination
- Nanostructured sorbents for analytical preconcentration of pollutants
- Phytoindications of groundwater pollution (phytoaccumulation, phytoremediation)
- Advanced methods of chemical instrumental analysis

COOPERATION

- Analytical background for internal research groups, external scientists and industrial customers
- Solving common environmental problems with a focus on pollutants

doc. Ing. Stanislaw Witold Waclawek, Ph.D.
Head of OECH



DEPARTMENT OF ENVIRONMENTAL CHEMISTRY



Analytical Laboratory of
CXI TUL

L. Lacinová

accredited by CIA under number 1611

It offers for companies, institutions and, citizens,
project and industrial partners:

- A sampling of drinking, warm and bathing waters
- Chemical and microbiological water analyses
- Chemical analysis of leachates, soils and sludges
- Checking the efficiency of sterilizers and autoclaves



DEPARTMENT OF NANOCHEMISTRY



doc. RNDr. Michal Řezanka, Ph.D.
Head of ONCH

MAIN RESEARCH ACTIVITIES

- Synthesis of chemical compounds
- Use of sol-gel method for preparation of nanomaterials
- Preparation of cyclodextrin-functionalized nanomaterials
- Use of nanomaterials in tissue engineering and catalysis

COOPERATION

- Physico-chemical analyses of (nano)materials
- Synthesis of organic or inorganic compounds
- Preparation of nanoparticles
- (Nano)material functionalization
- Organic and inorganic chemistry consulting



DEPARTMENT OF APPLIED BIOLOGY



RNDr. Alena Ševců, Ph.D.
Head of OABI

MAIN RESEARCH ACTIVITIES

- Development of nanomaterials and porous structures for regenerative medicine, drug delivery and cosmetics
- Study of microbial activity in relation to the safety of radioactive waste repositories
- Influence of nanomaterials and microplastics on natural microbial communities

COOPERATION

- Verification of antimicrobial efficacy of photocatalytic surfaces
- Bioremediation, the impact of remediation interventions on microbial communities
- Electrospinning, development of nanofiber matrices and nanomaterials
- Risks of nanomaterials
- Evaluation of interactions of nanomaterials with tissue cells



PROJECT SOLUTIONS (E.G.)



LIFEPOPWAT

prof. Dr. Ing. Miroslav Černík, CSc.

e-mail: miroslav.cernik@tul.cz
tel.: +420 485 353 178



EU LIFE program



LIFEPOPWAT (Innovative technology based on constructed wetlands for treatment of pesticide contaminated waters) is a European project that combines chemical and microbiological water treatment technologies. The essence of the demonstration system is the Wetland+ wetland cascade, which removes halogenated pollutants from flowing waters with low operating costs.

The aim of the project is to show the functionality of the technology on a full-scale prototype with a flow rate of over 100,000 m³ per year and to verify the procedures for its optimization aiming at smaller and larger water flows with different chemical composition.



SURRI



prof. Dr. Ing. Miroslav Černík, CSc.

e-mail: miroslav.cernik@tul.cz
tel.: +420 485 353 178



EU HORIZON TWINNING

The project SURRI aims to establish a multinational shared research agenda and project pipeline for addressing the challenges radionuclides pose to land remediation and materials recovery, with a particular focus on rare earth elements (REE) and other critical elements, in order to facilitate more efficient cycling and management of water, soil and material resources.

The research concept is based on the integration of electrochemical and microbiological interventions, which can be applied, in-situ or ex-situ, to provide new tools to unlock the remediation of radionuclide affected sites.

TECHNICAL
UNIVERSITY
OF LIBEREC



SAPIENZA
UNIVERSITÀ DI ROMA



University of
Southampton



UNIVERSIDAD
DE GRANADA

SURRI





LIFE4ZOO

Ing. Tomáš Lederer, Ph.D.

e-mail: tomas.lederer@tul.cz
tel.: +420 485 353 260



EU LIFE program

LIFE4ZOO

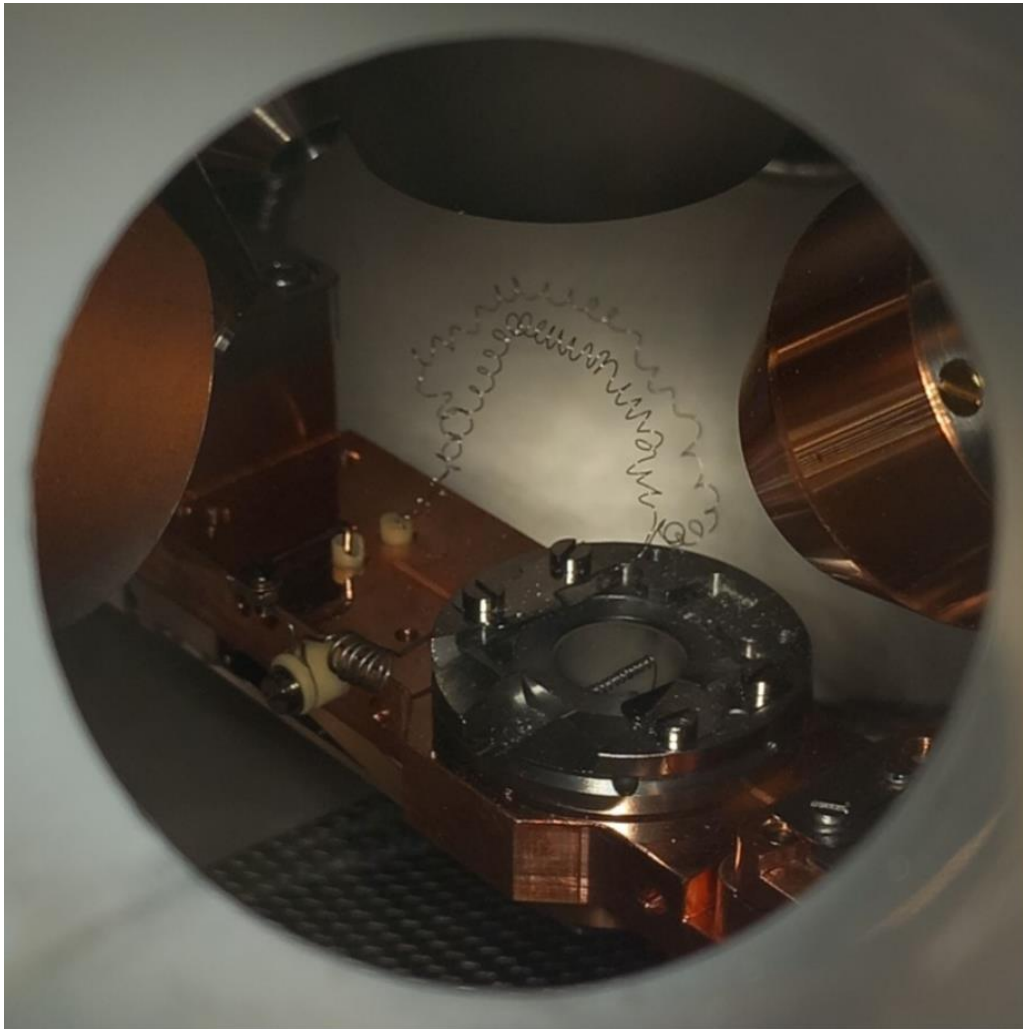
LIFE4ZOO (Water Resources Management in Visitor Attractions - FIT4USE Water Recirculation Technology) is a European project aiming to create a "circular economy" system for water use in visitor attractions such as Zoos.

The benefits of water recirculation are reduced demand on primary water resources, reduced cost-saving, reduced demand on sewerage systems and multiple synergies with better use of energy and water resources.

TECHNICAL UNIVERSITY OF LIBEREC **Universitat de Girona**  **Fundació Solidaritat**
UNIVERSITAT DE BARCELONA

 **ZOO LIBEREC**  **ZOO Barcelona**





PROJEKT

UPGRADE A MODERNIZACE VVI NANOMATERIÁLY A NANOTECHNOLOGIE PRO OCHRANU ŽIVOTNÍHO PROSTŘEDÍ A UDRŽITELNOU BUDOUCNOST

je spolufinancován **Evropskou unií**.

Cílem projektu Pro-NanoEnviCz III je modernizace přístrojové základny, která posílí výzkumný potenciál VVI NanoEnviCz a povede k úspěšnému splnění vědeckých cílů v oblasti nových nanomateriálů a nanotechnologií.



Spolufinancováno
Evropskou unií

MŠMT
MINISTERSTVO ŠKOLSTVÍ,
MLÁDEŽE A TĚLOVÝCHOVY



Více projektů podpořených Evropskou unií na www.mapaprojektu.cz





Inovativní způsoby energetickoprovozní optimalizace membránových bioreaktorů - CZ.01.01.01/01/22_002/0000552

je spolufinancován **Evropskou unií**.

Významným přínosem pro další rozšíření technologie MBR a také cílem tohoto projektu je energetická optimalizace zajištění proudění aktivovaného kalu kolem membrán.



Spolufinancováno
Evropskou unií



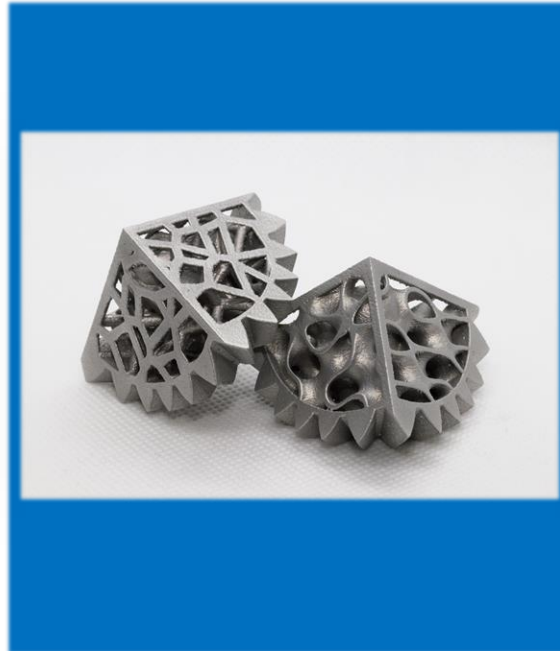
Více projektů podpořených Evropskou unií na www.mapaprojektu.cz



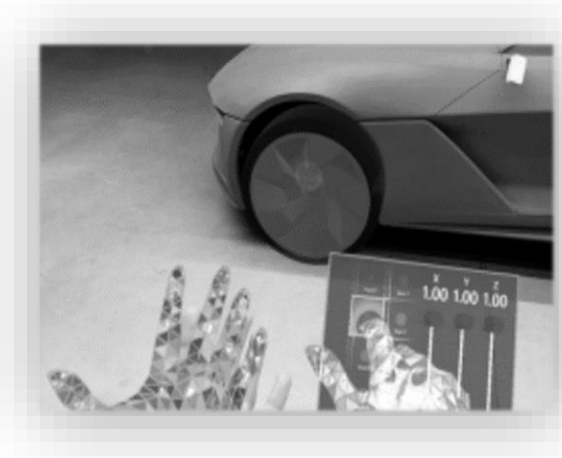
CXI RESEARCH DIRECTIONS



**Nanomaterials in
natural sciences**



**Competitive
engineering**



System integration



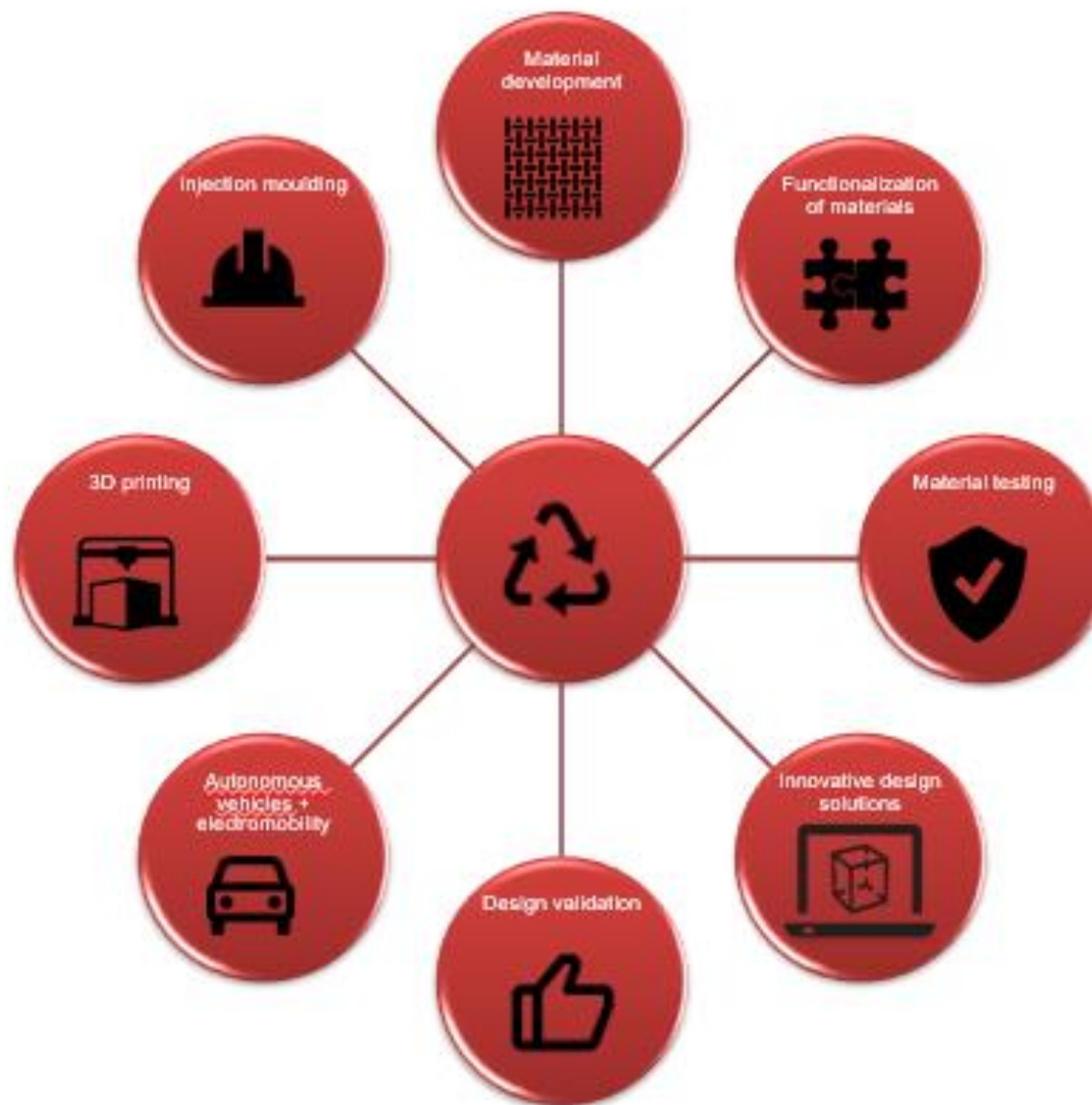
RESEARCH DIRECTION NO. 2



Ing. Jiří Šafka, Ph.D.
Head of RD2



**Competitive
engineering**



COMPETITIVE ENGINEERING



DEPARTMENT OF
3D TECHNOLOGIES



DEPARTMENT
OF VEHICLES



DEPARTMENT OF
MACHINES DESIGN



DEPARTMENT OF
ADVANCED TECHNOLOGIES



DEPARTMENT OF
ADVANCED MATERIALS

The research direction of **competitive engineering** combines research and development in the areas of manufacturing and the automotive industry with great application potential. The workplaces support the industrial activities of companies not just in the close-by regions and focus on the application of new technologies and technological procedures to ensure a higher degree of innovation in industrial production.



DEPARTMENT OF 3D TECHNOLOGIES

MAIN RESEARCH ACTIVITIES

- Advanced research in specialized additive technologies
- Comprehensive activities include not only 3D printing using the most appropriate technology concerning the material to be processed and the targeted product properties but also data preparation, optimization of product geometries or their elements (topological optimization), post-processing operations and the development of new sustainable materials for additive technologies
- Investigating different technological approaches to accuracy, and quality of output parts to increase application possibilities and usability of 3D printed products

COOPERATION

- Research and development of 3D printing technologies
- Design of application-specific 3D printing components and topological optimization
- New 3D printing applications in plastics and metals
- Development of new sustainable materials for 3D printing technologies



Ing. Filip Vele
Head of O3D



DEPARTMENT OF VEHICLES



Ing. Josef Broušek, Ph.D.
Head of OVZ

MAIN RESEARCH ACTIVITIES

- Development and testing of propulsion systems and engines
- Research and development in the field of electromobility
- Research of economic-emission properties of petrol and diesel internal combustion engines for liquid, gaseous fuels and their mixtures
- Power transmission systems in classical and hybrid engine arrangements

COOPERATION

- New hybrid drive systems
- Modifications of mobile and stationary devices meeting future EU 6 emission limits and greenhouse gas limits with emphasis on the use of new types of fuels from renewable sources



DEPARTMENT OF MACHINES DESIGN



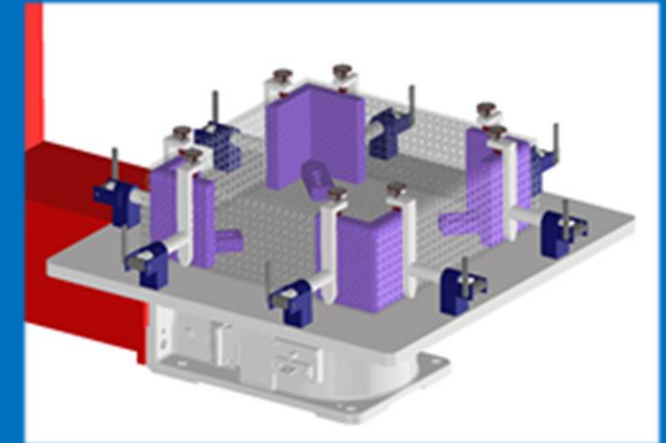
doc. Dr. Ing. Ivan Mašín
Head of OKS

MAIN RESEARCH ACTIVITIES

- Human safety and comfort in vehicles (land, air, water)
- Testing of new concepts and constructions of parts of mobile means of transport
- Mechatronic systems with active regulation

COOPERATION

- Custom machine design
- Measurement of physical properties of active and passive vibration-insulating materials
- Implementation of advanced technologies for product and equipment development using new procedures and methods



DEPARTMENT OF ADVANCED TECHNOLOGIES



Ing. Jiří Bobek, Ph.D.
Head of OPT

MAIN RESEARCH ACTIVITIES

- Development, research, innovation and application of progressive non-chip technologies for processing plastics, composites, metals and non-ferrous metals (casting, welding, forming and processing of plastics and composites)
- Parametrization of technological processes, optimization of processes with regard to efficiency, economy and the environment

COOPERATION

- Measurement of technological parameters during machining with defined and undefined cutting edge geometry
- Highly specialized measurements with unique devices
- Research, innovation and application of progressive technologies



DEPARTMENT OF ADVANCED MATERIALS



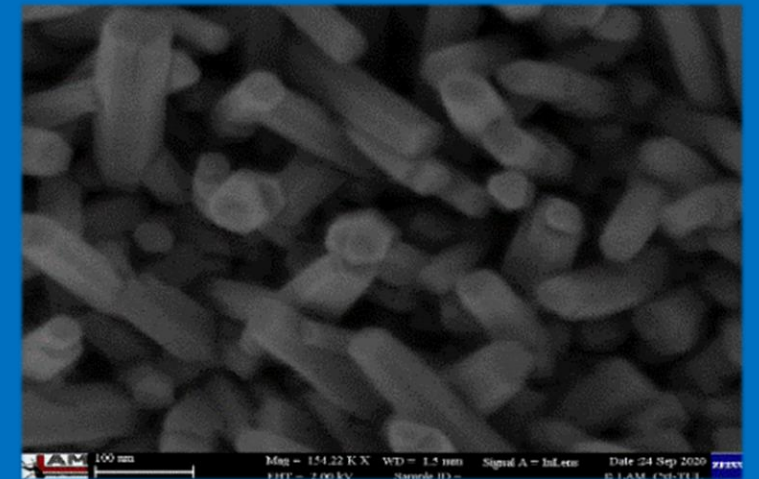
Ing. Mateusz Fijalkowski, Ph.D.
Head of OPM

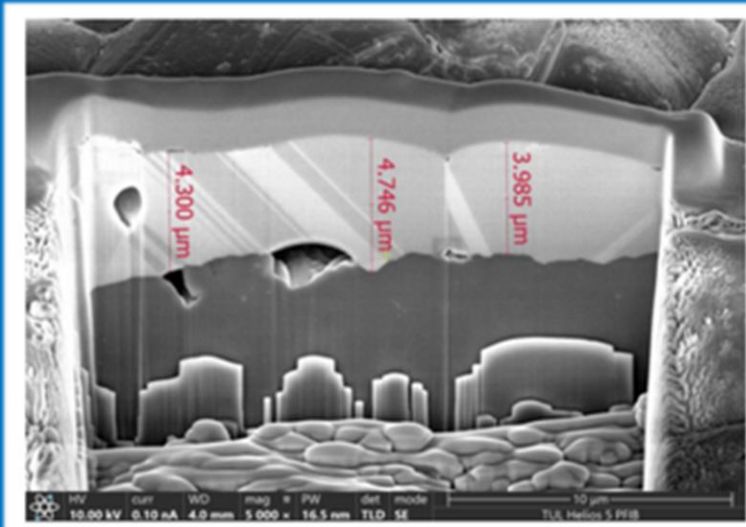
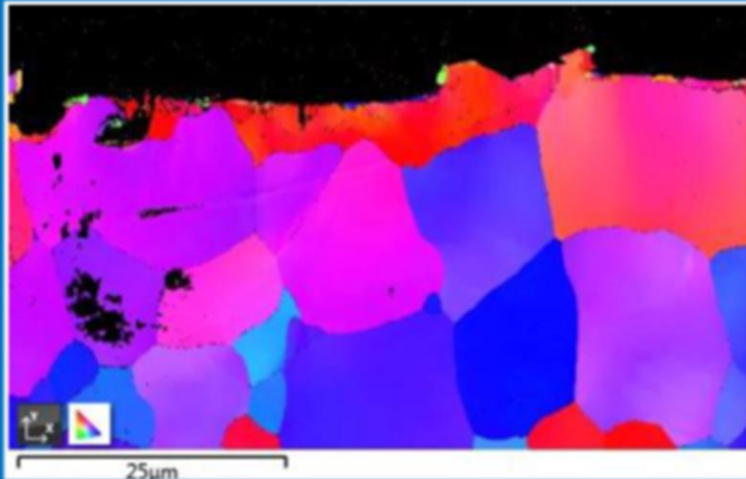
MAIN RESEARCH ACTIVITIES

- Optimized unconventional structures of materials with a high degree of functionality, study of these materials and search for new areas of application
- Elaboration of methodology for measuring properties of thin films and coatings
- Machining technology, creating new types of layers and coatings suitable for specific applications

COOPERATION

- Comprehensive analyzes of materials, including microanalysis
- Material research focused on the development of linear and three-dimensional nanofiber structures, study of nanoparticles
- Professional support in solving production and technological issues in the industrial sphere





Laboratory of Microscopy (LMI)

M. Fijalkowski

- Analyses of input and output materials of advanced technologies, in particular materials with thin films, nanoparticles or nanofibers
- Materials research focused on the development of linear and three-dimensional nanofibrous formations, the study of new materials containing nanoparticles, composite materials and others
- Application of analysis results in materials research



PROJECT SOLUTIONS (E.G.)



JOSEF BOŽEK COMPETENCE CENTRE FOR THE AUTOMOTIVE INDUSTRY

Ing. Robert Voženílek, Ph.D.

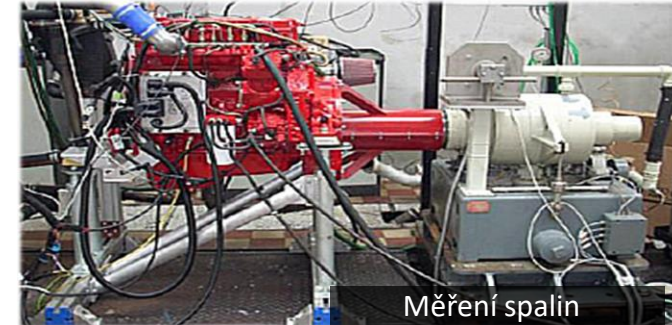
e-mail: robert.vozenilek@tul.cz
tel.: +420 485 353 376

Goals:

- reducing the consumption of fossil fuels,
- reduction of CO₂ emissions,
- increase safety and comfort.

The Center develops future means of sustainable mobility of road and rail vehicles and further develops the technical levels of fields important for the economy of the Czech Republic.

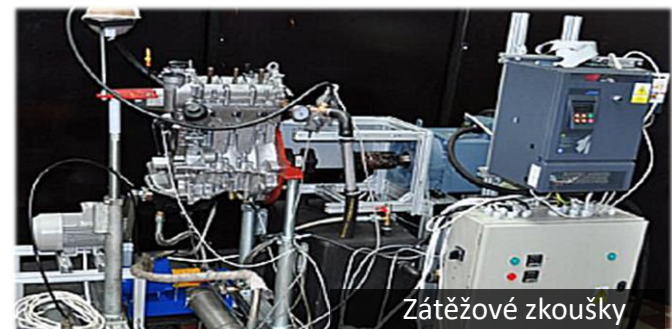
Connects **4 universities**: TUL, ČVUT, VUT Brno, VŠB,
and **9 industrial partners**: Škoda Auto a.s., TÜV SÜD Czech s.r.o., Ricardo Prague s.r.o., MOTORPAL a.s., Honeywell, spol. s r.o., BRANO a.s., ČZ a.s., AICTA Design Work, s.r.o. and TATRA, a.s.



Měření spalin



Válcová brzda



Zátěžové zkoušky





P3DT

Ing. Jiří Šafka, Ph.D.

e-mail: jiri.safka@tul.cz
tel.: +420 485 353 801

P3DT



CENTRUM
PRO PRŮMYSLOVÝ
3D TISK



NCK TAČR – Centre for Industrial 3D Printing

The main objective is to **increase the potential of additive technologies** through the efficient and environmentally friendly use of raw materials or energy, the development of materials with specific properties and the creation of new products, the design of appropriate technologies and the use of digitalization, enabling a high degree of optimization.

The objective will be achieved by implementing sub-projects involving at least 26 partners, resulting in at least 80 applied research results with high implementation potential.

A secondary objective is **creating a platform** exploiting the multiplier effect of interdisciplinary networking of research organisations and industrial leaders with shared know-how, which will facilitate the long-term and sustainable development of additive technologies in the Czech Republic and thus increase its competitiveness.





MATCA

Ing. Michal Ackermann, Ph.D.

e-mail: michal.ackermann@tul.cz
tel.: +420 485 353 723

TUL expert in the field of metal 3D printing and topological optimization, industrial design

Ing. Jan Kočí

e-mail: jan.koci@tul.cz
tel.: +420 485 353 606

Digitalisation, management, enterprise and software architecture, integration



NCK TAČR - National Centre of Competence for Materials, Advanced Technologies, Coatings and their Applications II

The centre mainly develops additive, plasma, and laser technologies. Given their impact on industry, economy and security, mastering and developing these technologies is strategically essential. We are developing 3D printing, plasma, lasers, surface treatment, simulation, analysis, and digitalization.

Within the framework of long-term R&D projects, NCK MATCA covers the entire product life cycle smart design through environmentally friendly production, repair, and restoration of functional properties to dispose of hazardous waste.





Interreg



Kofinanziert von
der Europäischen Union
Spolufinancováno
Evropskou unií

Sachsen - Tschechien | Česko - Sasko

SUPPORT4SME Grenzüberschreitende Unterstützung für die Beteiligung von KMU an der zukünftigen Materialforschung SUPPORT4SME Přeshraniční podpora zapojení malých a středních podniků do materiálového výzkumu budoucnosti

Hauptziel des Projektes

Hlavní cíl projektu

Entwicklung und Bearbeitung gemeinsamer Forschungsthemen und Bereitstellung von wissenschaftlichen Dienstleistungen.
Rozvoj a řešení společných výzkumných témat a poskytování služeb aplikovaného výzkumu.

Leadpartner: Technische Universität in Liberec
Technická univerzita v Liberci



Projektpartner: Technische Universität Chemnitz
Technická univerzita Chemnitz



Gesamtkosten des Projektes
Celkové náklady projektu

3.052.522,28 Euro



Mehr Informationen über das Programm finden Sie auf unserer Website!
Více informací o programu najdete na našich webových stránkách!



www.sn-cz2027.eu





ELECTROMOBILITY

doc. Ing. Michal Petrů, Ph.D.

e-mail: michal.petru@tul.cz
tel.: +420 485 353 833



OP VVV - Modular platform for autonomous chassis of specialized electric vehicles for freight and equipment transportation

The aim of the project is the development and experimental verification of a competitive autonomous battery vehicle for the transport of medium and higher weight loads in general terrain.

Solutions to the following scientific research problems represent partial goals of the project:

- modular architecture of the chassis using so-called light constructions,
- drives and accumulators for autonomous commercial electric vehicles,
- research in the field of autonomous commercial electric vehicle control systems using shared reality or the Internet of Things to interact with other entities.

Potential users are logistics operations in the general terrain (construction, mining, agriculture, industrial enterprises, special forces).





Interreg



Kofinanciert von
der Europäischen Union
Spolufinancováno
Evropskou unií



Sachsen – Tschechien | Česko – Sasko

Projekttitel:

Interdisziplinäre Brücke – InterBridge

Název projektu:

Interdisciplinární most – InterBridge

Hauptziel des Projektes

Hlavní cíl projektu

Die Region Liberec und Sachsen verfügen über ein reiches kulturelles und wissenschaftliches Erbe sowie über begabte Künstler und Wissenschaftler. Deshalb wurde dieses Projekt ins Leben gerufen, um dieses Potenzial zu nutzen und die Zusammenarbeit zwischen Wissenschaft und Kunst auf grenzüberschreitender Ebene zu entwickeln. Das Hauptziel von Interbridge besteht darin, Wissenschaft und Kunst vor allem durch Bildung, neue Technologien und Materialforschung zu verbinden.

Liberecký kraj a Sasko mají bohaté kulturní a vědecké dědictví i talentované umělce a vědce. Proto vznikl projekt, který by umožnil využití tohoto potenciálu a rozvoj spolupráce mezi vědou a uměním na přeshraniční úrovni. Interbridge má jako hlavní cíl propojení vědy a umění především prostřednictvím vzdělávání, nových technologií a materiálového výzkumu.

Leadpartner: Technische Universität in Liberec

Technická univerzita v Liberci

Projektpartner: Technische Universität Chemnitz

Technická univerzita v Chemnitz

Gesamtkosten des Projektes

Celkové náklady projektu

1.190.487,12 Euro



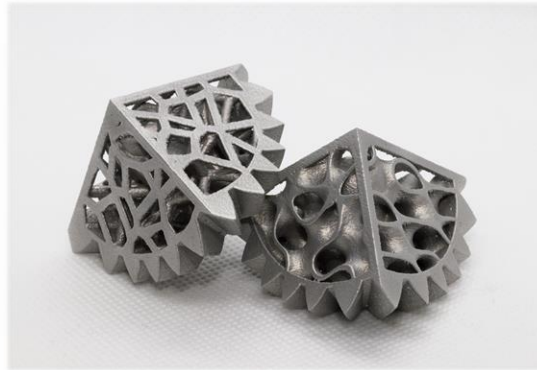
Mehr Informationen über das Programm finden Sie auf unserer Website!
Více informací o programu najdete na našich webových stránkách!



CXI RESEARCH DIRECTIONS



**Nanomaterials in
natural sciences**



**Competitive
engineering**



System integration



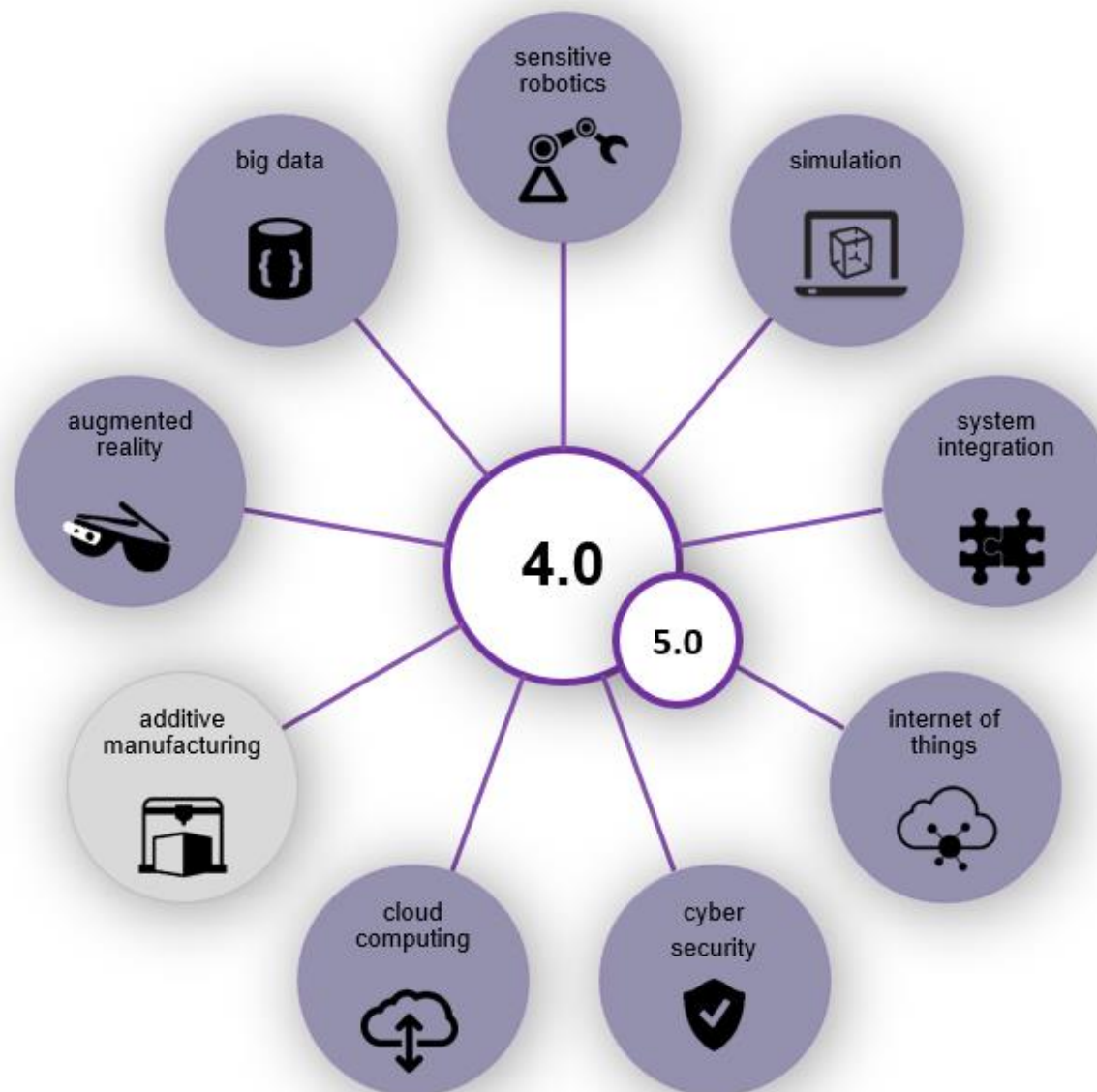
RESEARCH DIRECTION NO. 3



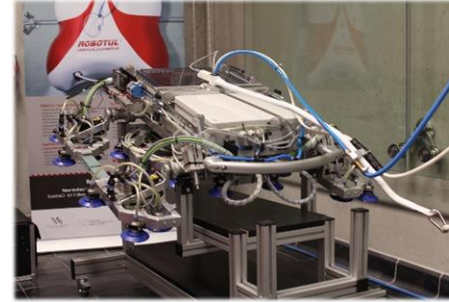
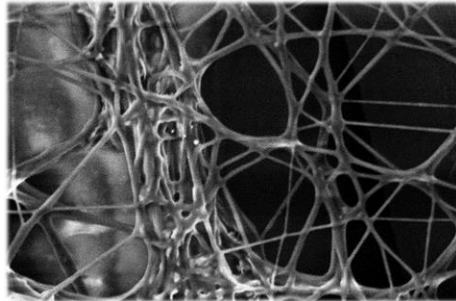
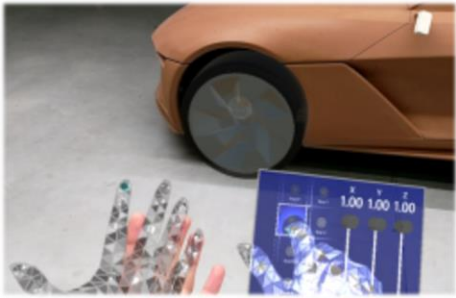
Ing. Jan Kočí
Head of RD3



System
integration



SYSTEM INTEGRATION



DEPARTMENT OF SOFTWARE AND
ARTIFICIAL INTELLIGENCE

DEPARTMENT OF HARDWARE
AND SENSORICS

The research direction **system integration** focuses on research and development of modern software solutions, system solutions for data processing and integration between systems, and the provision of communication interfaces. An integral part of the direction is the field of robotics, including the use of collaborative or sensitive robots. The emphasis is being put on the introduction of state-of-the-art elements of visualization and projection of measured data, including the use of mixed / augmented reality.



DEPARTMENT OF SOFTWARE AND AI



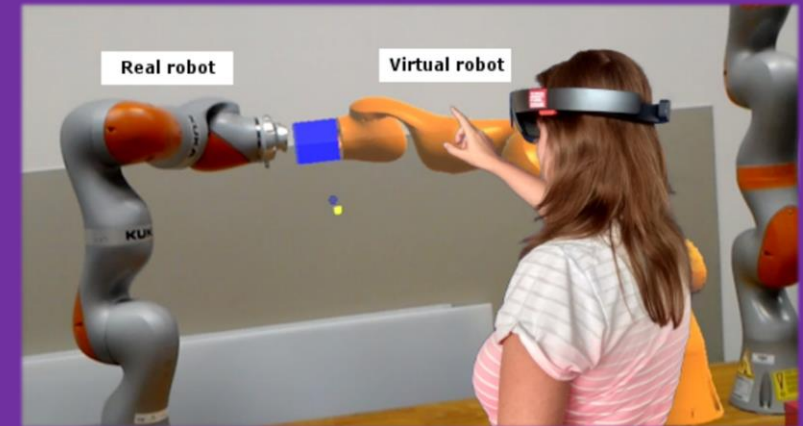
Ing. Jindřich Cýrus, Ph.D.
Head of OSAI

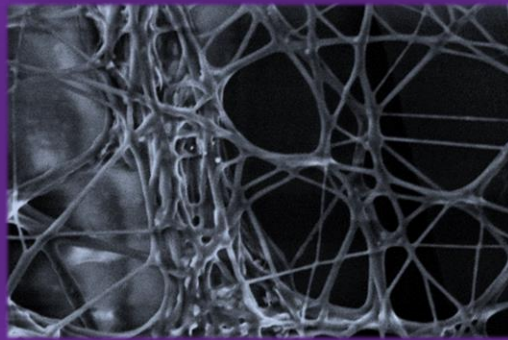
MAIN RESEARCH ACTIVITIES

- Research and development of modern SW solutions, system solutions for data processing and integration between systems and provision of communication interfaces
- Designing the architecture of SW and HW solutions in target processes using IoT devices, Cloud services and augmented reality
- Industry 4.0 pillars in product design and development
- Process modelling using mathematical, physical and numerical methods or machine learning and artificial intelligence principles
- Robot process automation
- Big data storage, processing and analysis
- Application of a data-driven approach to business/manufacturing processes

COOPERATION

- Design and application of IoT Technologies
- Use of augmented and mixed reality
- Design and implementation of artificial intelligence algorithms in processes
- Architecture of cloud solutions, image and pattern recognition
- Machine learning and prediction models, data storage, analysis, reporting
- Robotic process automation





Laboratory of
Information Systems

P. Ječmen

- Architecture
- Security
- SW development
- AR development



Laboratory of Process Modelling
and AI (LMAI)

V. Chumchal

- Data stores
- Bigdata analysis
- ML/AI recognition of audio,
video, LLM and chatbots



DEPARTMENT OF HARDWARE AND SENSORICS

MAIN RESEARCH ACTIVITIES

- Innovative research on autonomous service robots
- Development of robotic process workstation sub-assemblies and integration into production lines
- Solution of specific design nodes of industrial robots and their effectors, mechatronic elements of automation technology and peripherals of robotic workplaces
- R&D and use of means and methods for non-contact detection and measurement
- Measurement of physical quantities in industrial technological processes
- Experimental research in fluid mechanics
- Image information processing in the industry

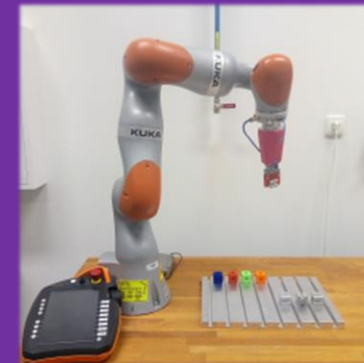
COOPERATION

- Implementation of high-intelligence elements and new materials in robotic and mechatronic systems with multiple degrees of freedom
- Rehabilitation robotics (exercise bikes, medical beds, etc.)
- Development and application of non-contact measurements in industrial applications

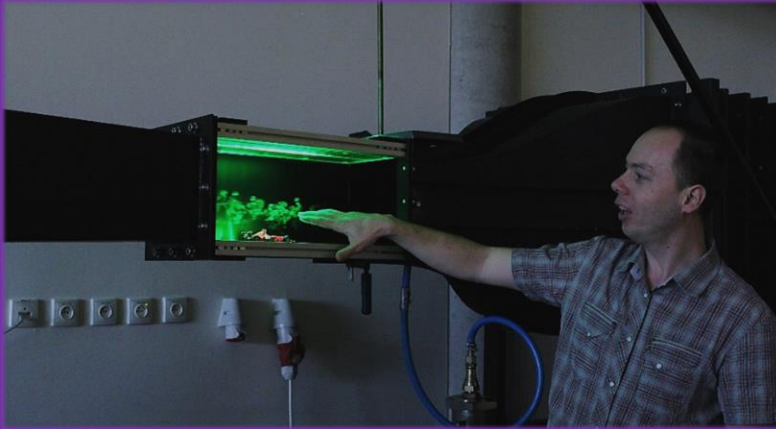
Applications of "Global Imaging Methods" (LDA, PIV, micro PIV, PLIF, IPI)



doc. Ing. Tomáš Martinec, Ph.D.
Head of OHS



DEPARTMENT OF HARDWARE AND SENSORICS



Laboratory of Physical Measurements (LFM)

M. Kotek

- Optics and lasers
- Acoustics
- Currents



Laboratory of Mechatronics and Robotics

T. Buchta

- Robotics
- Sensorics
- Electronics
- Communication



PROJECT SOLUTIONS (E.G.)



EDIH

Ing. Jan Kočí

e-mail: jan.koci@tul.cz
tel.: +420 485 353 606



EDIH Northern and Eastern Bohemia

The European Digital Innovation Hub - North and East Bohemia builds on the existing networking of the professional and technological know-how of progressive digitalization activities of its partners, who have long provided services in the field of digital transformation of SMEs and public institutions, innovation, technical education and basic and applied research - all in connection with artificial intelligence and cybersecurity.





PROJEKT **LasApp**

Průlomové laserové technologie pro chytrou výrobu, vesmírné a biotechnologické aplikace

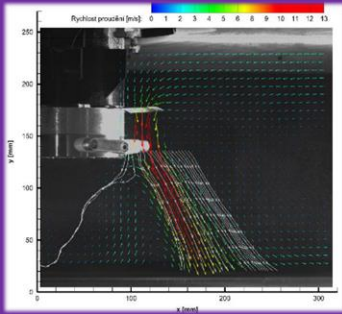
je spolufinancován **Evropskou unií**.

Rozvoj centra vědecké excelence a kompetence v **laserové** technice se zaměřením na vláknové a tenkodiskové lasery a jejich potenciální **aplikace**.



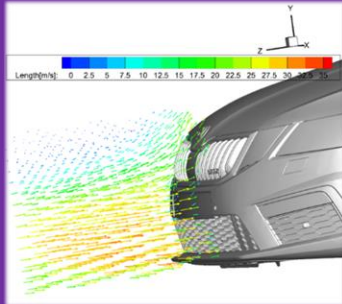
Spolufinancováno
Evropskou unií





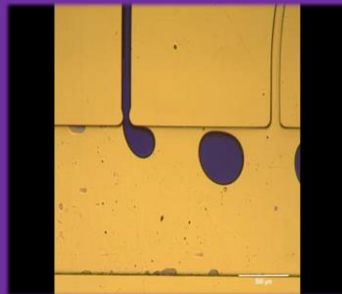
Nano4fibers, Roudnice nad Labem

Micro and nano fibers production – monitoring of the fiber production, investigation of the flow field in the production machine, fiber decomposition, CFD verification



ŠKODA AUTO, Mladá Boleslav

Characterization of the water droplet spray coming to the car front and engine's air suction inlet



Grade Medical, Praha

Development of fluidic micro-chips for drug delivery, controlled droplet production, measurement and suspension analysis



Aveton, Praha

Design and measurement of acoustic elements and structures, application of nanofiber membrane resonator, development of specific acoustical elements, acoustic measurements





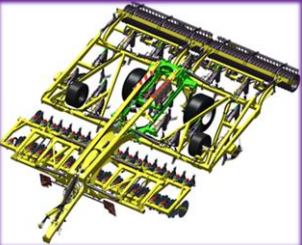
Kanfit Ltd., Israel

Development of robotic winding technology for the production of composite frames for the aviation industry



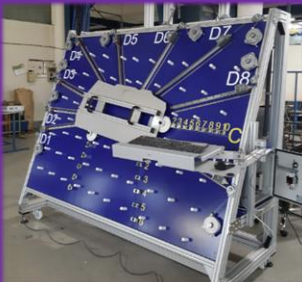
Carlex Glass Luxembourg S.A., Grevenmacher

Robotic production line for glass finishing with automatic quality check using IoT sensors, robot vision, 2D vision and 3D vision



BEDNAR FMT, Rychnov nad Kněžnou

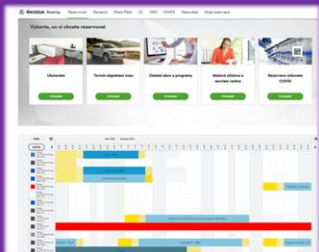
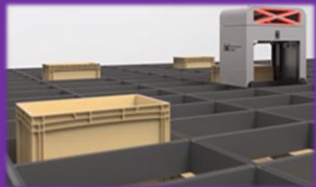
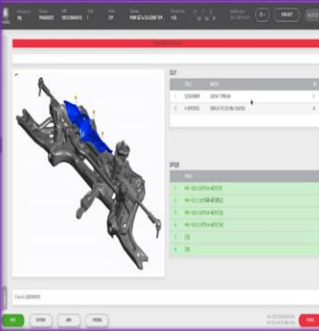
Autonomous IoT unit including energy harvesting for remote supervision of trailed agricultural machinery, monitoring the current state of the machine and evaluating possible critical conditions during its use



Saint-Gobain Sekurit, Hořovice

Measuring station for quality control of the production of 2D and 3D glasses for the automotive industry, sensors and data control





SVOTT, Mladá Boleslav

Product design optimization using AR techniques.
Programming apps for HoloLens.

ŠKODA AUTO, Mladá Boleslav

Design and implementation of a modular system for visualization on an automotive assembly line.
Development, integration and management of IIoT-based hardware and sensors.

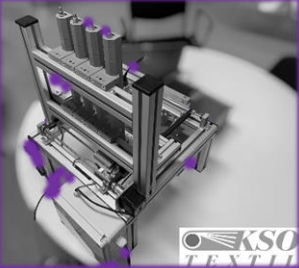
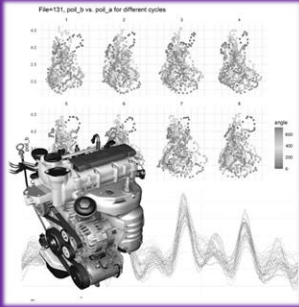
Systematic, Praha

Development of the management and IoT sensors, control system for the fully automated robotic warehouse with planning, visualisation and simulation modules for capacity and throughput testing using AI algorithms

ŠKODA AUTO, Mladá Boleslav

Universal reservation system development and management for a customer centre, meeting reservations, training, health and prevention programs, personal agenda, accountancy, and personal car management for journalists





ŠKODA AUTO, Mladá Boleslav

Data-driven design, preparation of digital-twin using AI for combustion engine oil management and its optimization

KSO Textil, Zittau, DE

Industrial vision and AI based automated quality check of textile machine device, replace manual work, increase productivity

DREVOPLAST Ludvík, Všelibice

Advanced raw material planning using ML and AI for plastics injection molding automotive SME company

ŠKODA AUTO, Mladá Boleslav

AI driven expert system for online analysis of the vibrodiagnostics data, PoC for integration platform and maintenance GUI



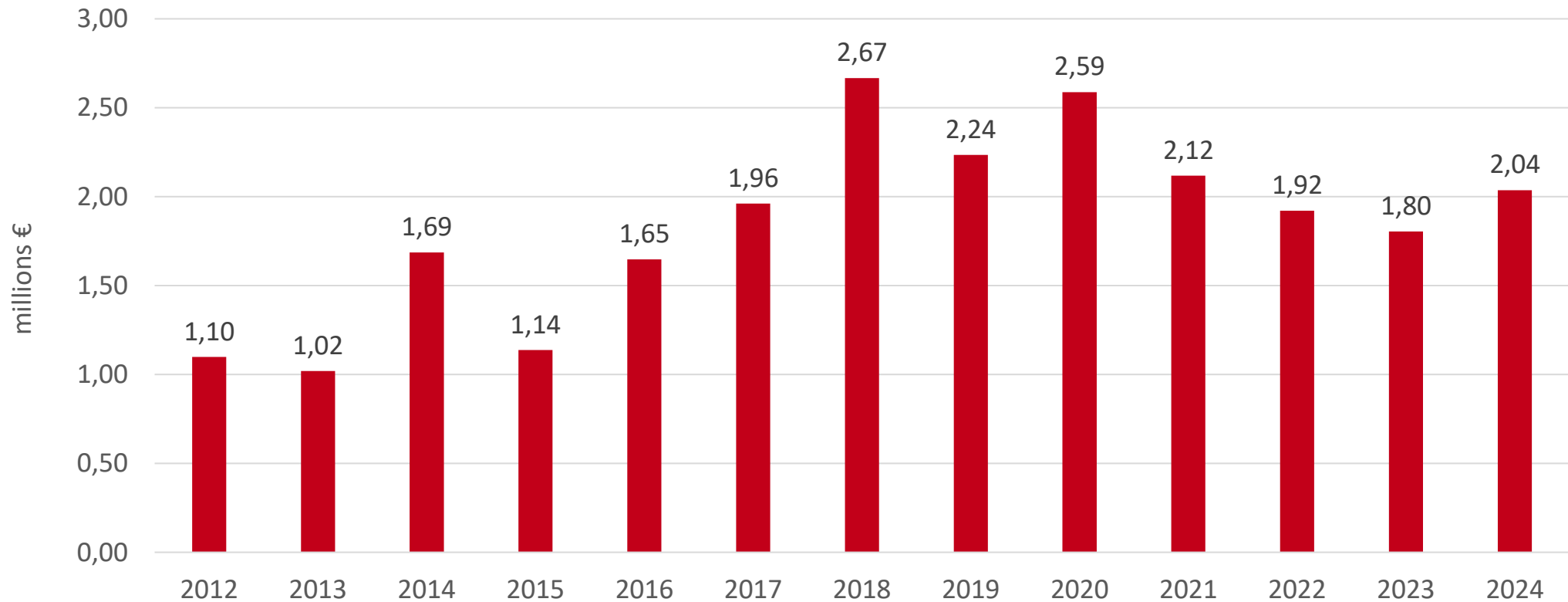


Interesting information



CXI TUL

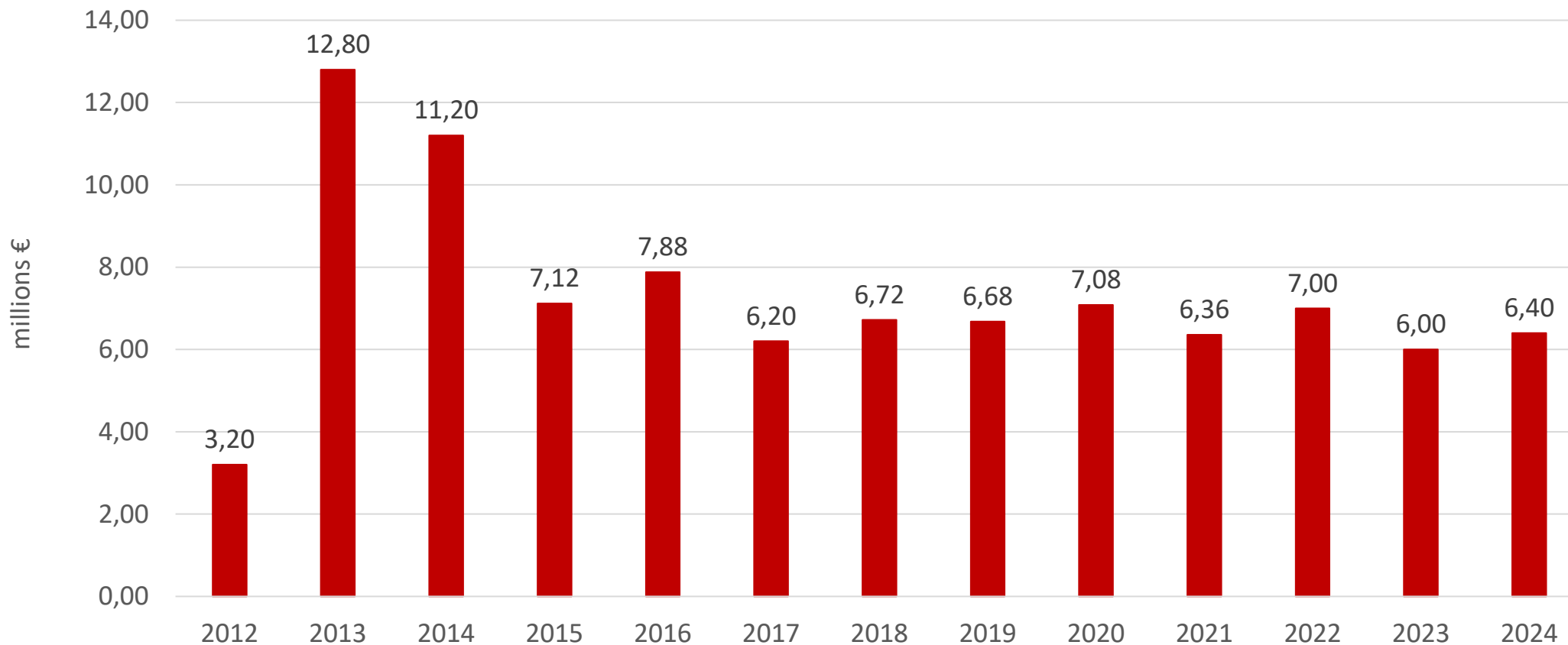
CONTRACT RESEARCH



- 2017: contract volume **1.96 mil. €**
- 2018: contract volume **2.67 mil. €**
- 2019: contract volume **2.24 mil. €**
- 2020: contract volume **2.59 mil. €**

- 2021: contract volume **2.12 mil. €**
- 2022: contract volume **1.92 mil. €**
- 2023: contract volume **1.80 mil. €**
- 2024: contract volume **2.04 mil. €**

NATIONAL AND INTERNATIONAL GRANTS



- 2017: **67 projects** in volume of **6.20 mil. €**
- 2018: **82 projects** in volume of **6.72 mil. €**
- 2019: **85 projects** in volume of **6.68 mil. €**
- 2020: **84 projects** in volume of **7.08 mil. €**

- 2021: **77 projects** in volume of **6.36 mil. €**
- 2022: **90 projects** in volume of **7.00 mil. €**
- 2023: **89 projects** in volume of **6.00 mil. €**
- 2024: **93 projects** in volume of **6.04 mil. €**

SUSTAINABILITY AT CXI



Documents:

- Sustainability Strategy 2030 CXI TUL
- CSR Report for each calendar year

SUSTAINABLE DEVELOPMENT GOALS



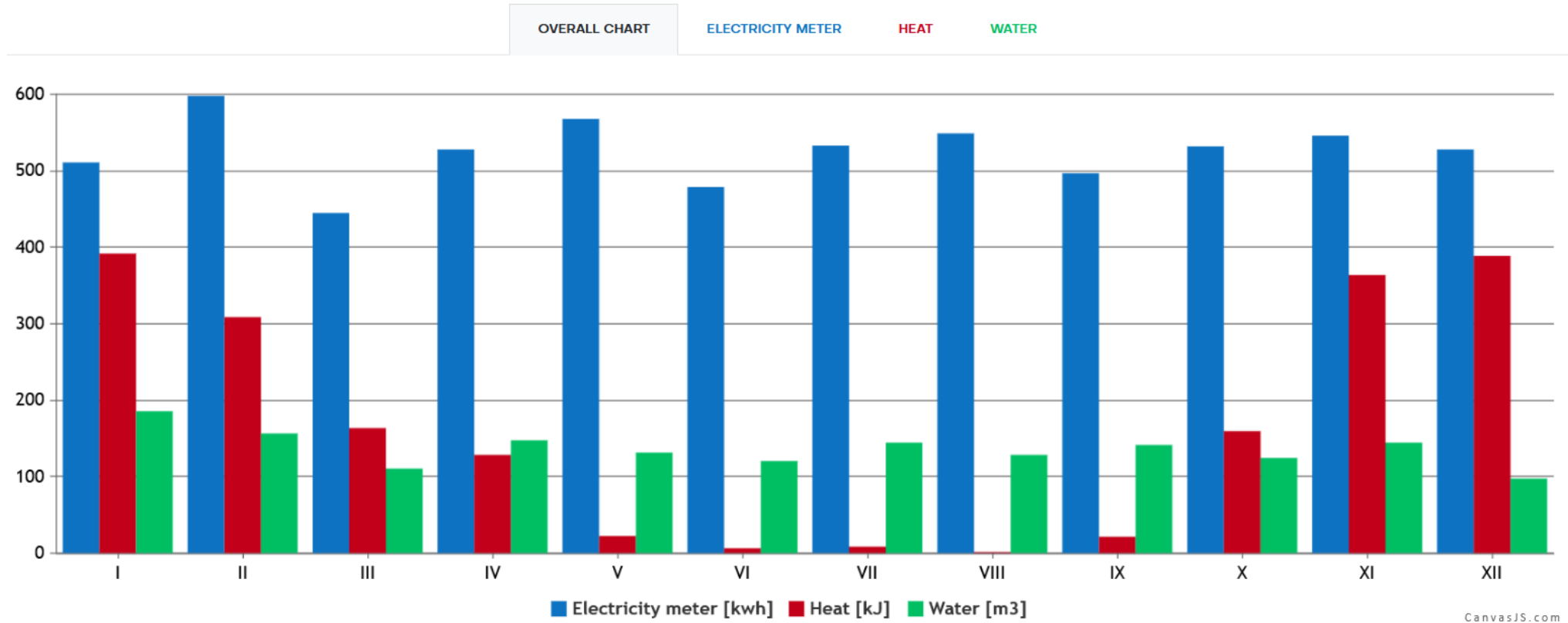
https://udrzitelnost.cxi.tul.cz/index_en.php



SUSTAINABILITY AT CXI



Monitoring monthly consumption at CXI (Building 'L'):



year 2024

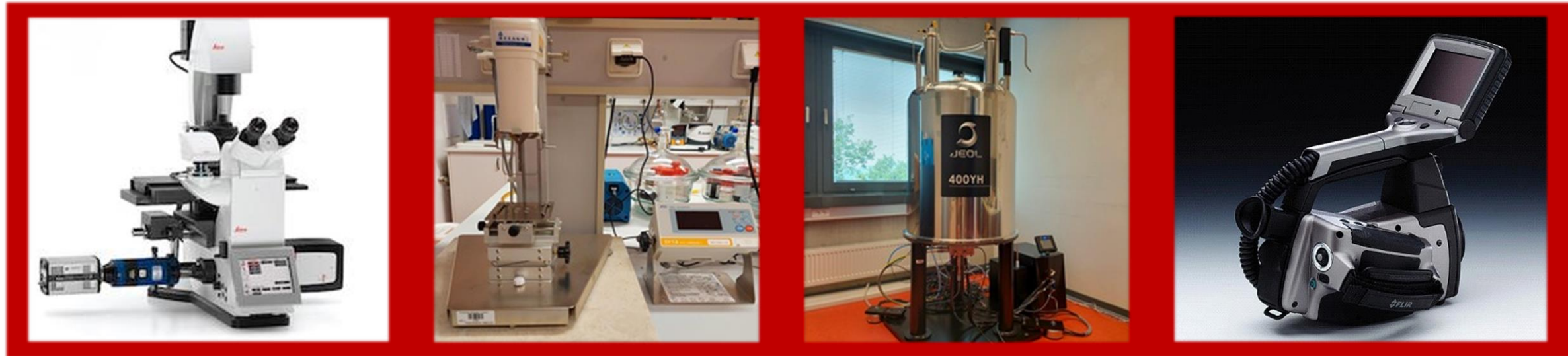
Measurement	January	February	March	April	May	June	July	August	September	October	November	December
■ Electricity meter [kwh]	511	598	445	528	568	479	533	549	497	532	546	528
■ Heat [kJ]	392	309	164	129	23	7	9	2	22	160	364	389
■ Water [m3]	186	157	111	148	132	121	145	129	142	125	145	98



TOOLS & EQUIPMENT



More than 100 machines > 15 mil. €



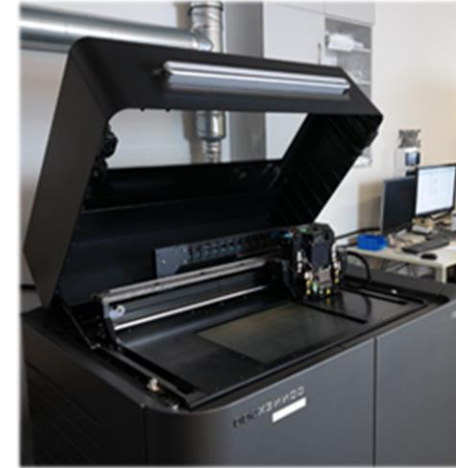
TOOLS & EQUIPMENT

(EXAMPLES)



Ion Electron Microscope Helios 5 PFIB Cxe

- Preparation of TEM and APT samples without Ga+ thanks to the new PFIB column, which enables final polishing with 500 V Xe+
- Automated in situ and ex-situ TEM sample preparation and cross-sectioning with optional AutoTEM 5 software
- Highest throughput and quality for statistically relevant 3D characterization, cross-sections and micromachining with the next-generation 2.5 μ A xenon plasma FIB (PFIB) column
- Access to high-quality multimodal subsurface and 3D information
- Shortest time to information acquisition at the nanoscale for users of any experience level with SmartAlign and FLASH technologies etc.



3D printer Objet Connex 500

- PolyJet Matrix Technology
- Objet's system is designed for the production of large and precise models
- Models and prototypes are strong, dimensionally stable and very easy to finish.



3D printer for metals SLM 280HL

- Selective Laser Melting technology fuses individual layers of metal powder to create a printed part with mechanical properties comparable to a machined part



TOOLS & EQUIPMENT



(EXAMPLES)



Ion Milling System SEM Mill 1060

- Device for precision polishing of surfaces with Ar ion beam
- Precision micro/nano-cutting with ion beam
- Two adjustable ion cannons



Dusting machine for SEM Quorum Q150R ES

- Combined carbon sputter and sputter of precious metals, especially gold, for surface conductivity of electrically non-conductive SEM samples



NS Line 1WS500U – Nanospider

- Industrial nanofibre production equipment
- The plant uses the principle and technology of electrical wetting
- It uses polymer solutions in a high-voltage electrostatic field to form nanofibers
- High voltage is generated between two electrodes



Carl Zeiss Ultra Plus

- Resolution 1 nm
- Complete microanalytical setup EDS + WDS + EBSD (OXFORD)
- 3D imaging capability with 4-quadrant AsB detector



TOOLS & EQUIPMENT



(EXAMPLES)



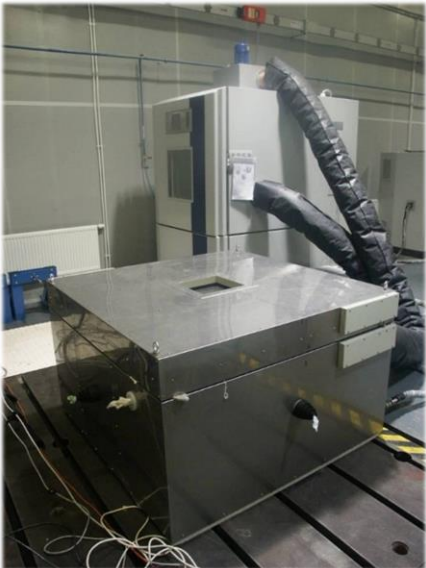
PowerTrain

- Possibility of testing 4x4 drive
- Possibility of testing the entire driveline (combustion engine - transmission - gearbox - transmission - half-axle - wheel)



3 Olympus I-Speed

- High-speed recording camera
- Fast action analysis



Climate chamber with external load boxes

- Testing in different temperature and humidity regimes
- Temperature range -70°C to 180°C
- Humidity 10 to 98% for temperatures from 10 to 95°C



Hexapod

- Implementation of general spatial movement or force excitation
- Six hydraulic motors arranged in a hexapod system
- Vibration-isolating base plate
- Two universal anchor frames



FORMS OF COOPERATION



Contractual research

Common projects
Research and Development

Services

Consortium - AMIA

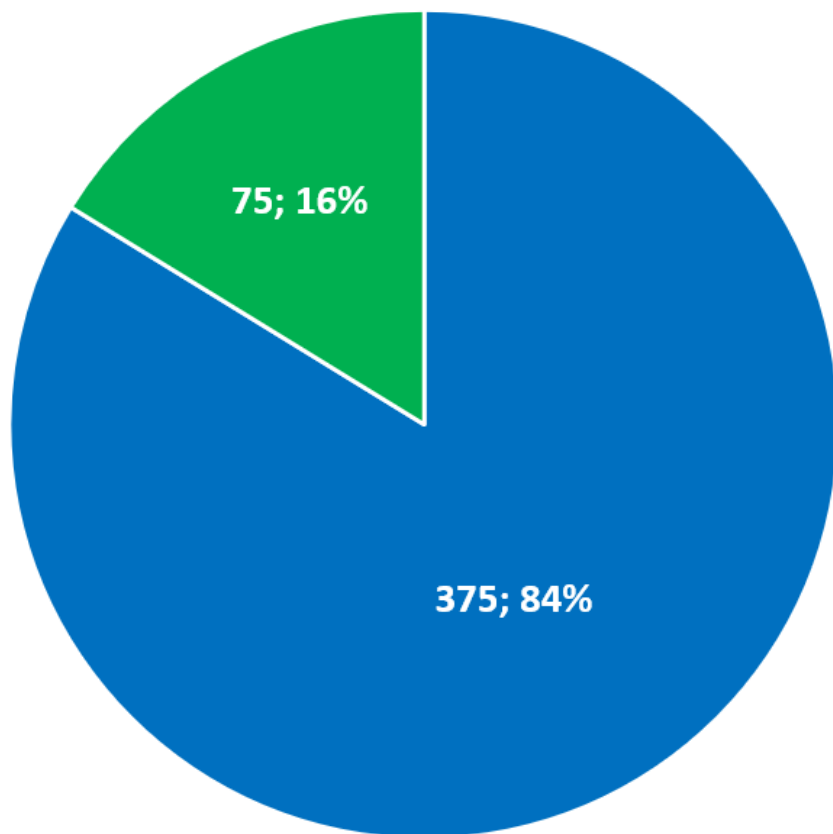


OUR PARTNERS (PROJECTS/CONTRACTS)



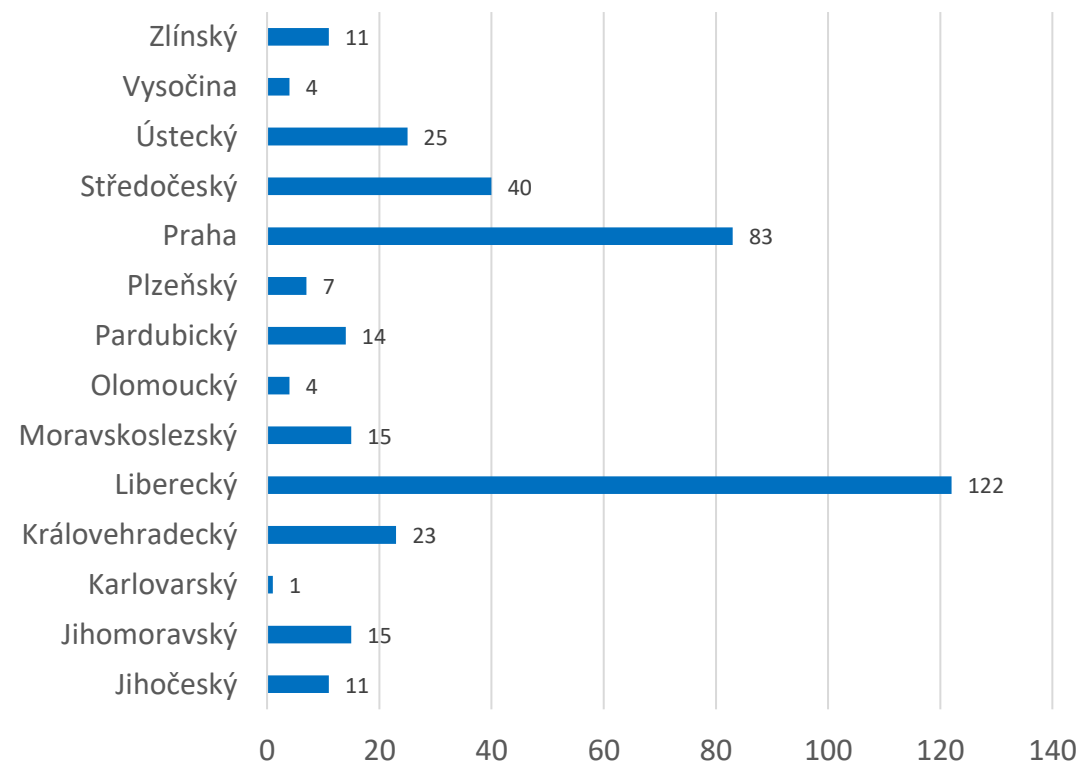
Structure of CXI TUL cooperating partners

PRIVATE SECTOR



■ Czech firms ■ foreign firms

Representation of Czech regions:



(period 2019 – 2024)



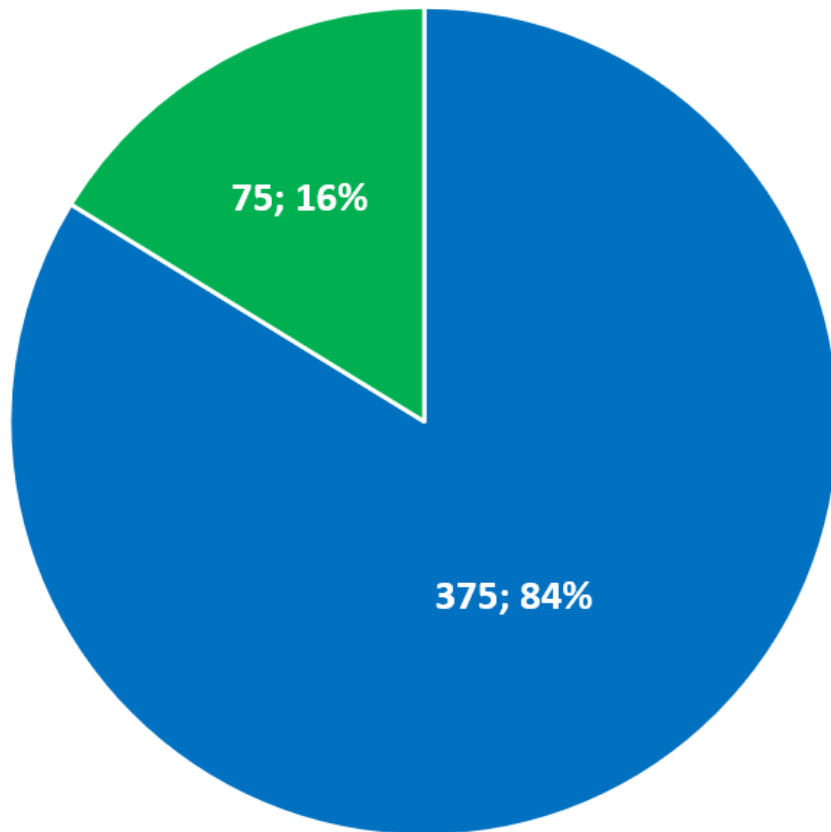
Note: only companies with orders > 30,000 CZK / year

OUR PARTNERS (PROJECTS/CONTRACTS)



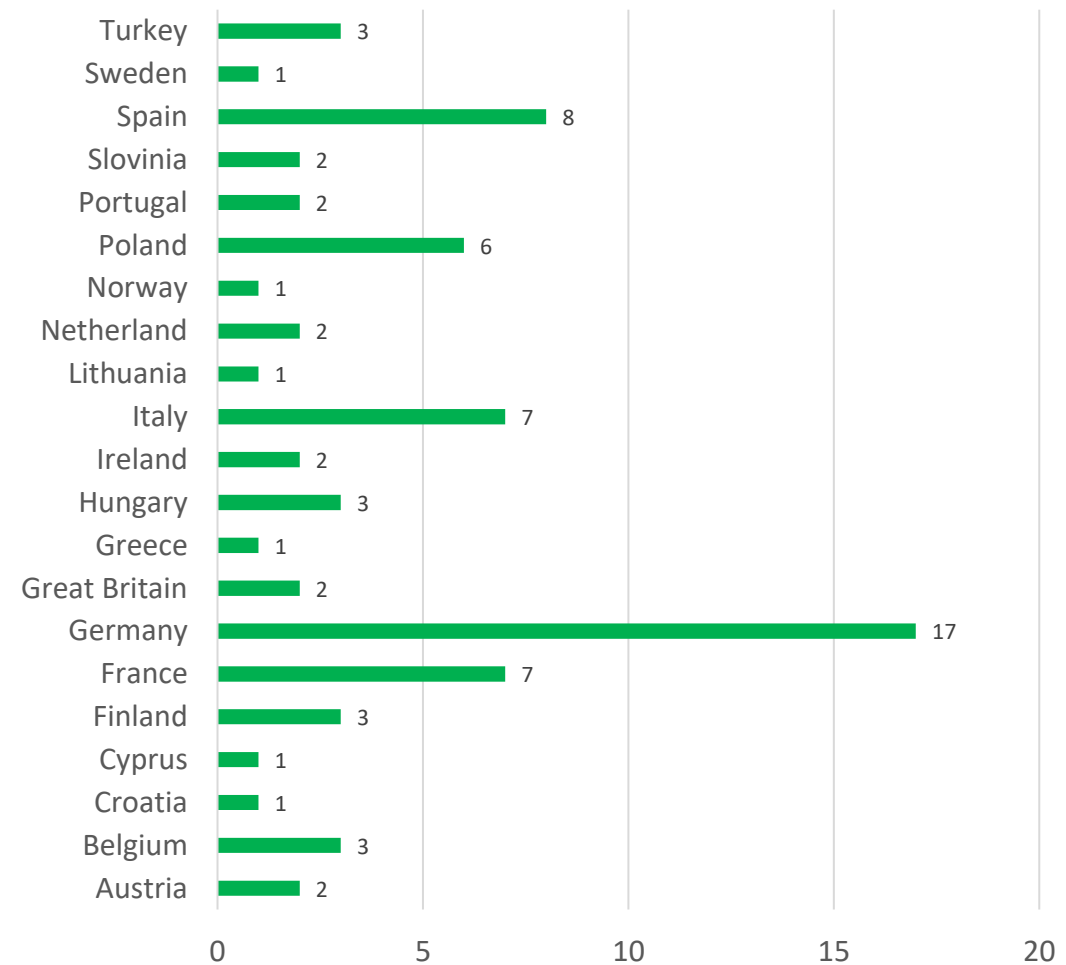
Structure of CXI TUL cooperating partners

PRIVATE SECTOR



■ Czech firms ■ foreign firms

Representation of individual countries
(seats of foreign private companies):



(period 2019 – 2024)

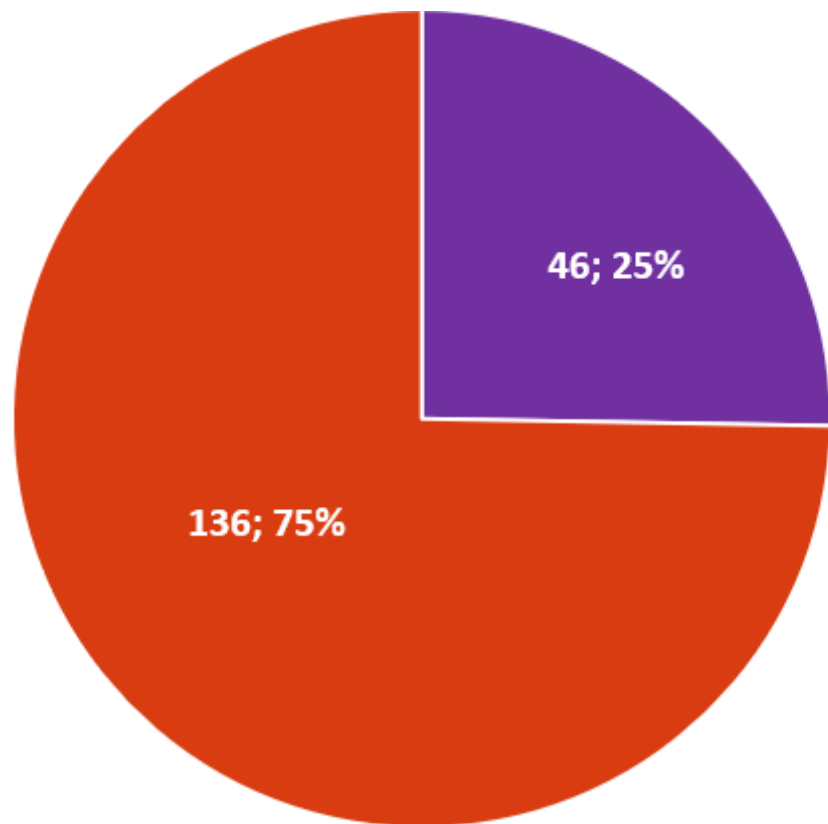


OUR PARTNERS (PROJECTS)

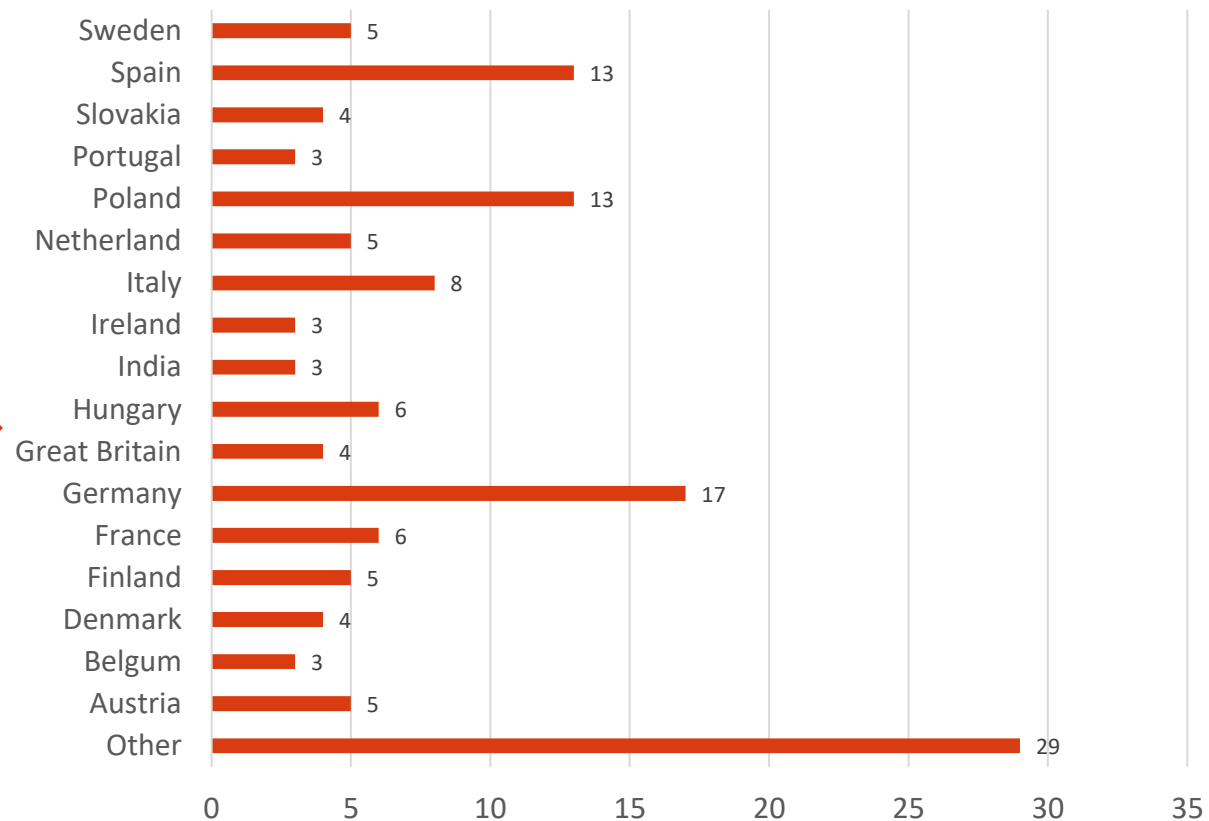


Structure of CXI TUL cooperating partners

PUBLIC SECTOR



Representation of individual countries
(seats of foreign universities and research institutes):



(period 2019 – 2024)



uni/institutes
in the CR

uni/institutes
outside the CR

Other (total 29; each 1 or 2): Brazil, Bulgaria, Columbia, Croatia, Greece, Indonesia, Israel, Japan, Latvia, Lithuania, Luxembourg, Norway, Slovinia, South Africa, Serbia, Switzerland, Thailand, Turkey, Ukraine, United States.

OUR PARTNERS



E.G. THE COMPANIES IN OUR REGION:



BOSCH



SKODA



PRECIOSA



Lersen



BEDNAR



etc.



Foto: Zuzana Bajtová (Fotobanka TUL)

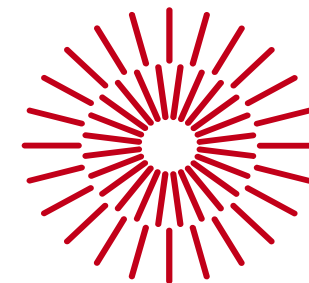


We look forward
to you!

CXI TUL



INSTITUTE FOR NANOMATERIALS,
ADVANCED TECHNOLOGIES
AND INNOVATION TUL



RESEARCH ON THE TOP

