

## **Project/Network title**

Concurrent Product and Technology Development - Teaching, Research and Implementation of Joint Programs Oriented in Production and Industrial Engineering

## **Introduction**

According to CEEPUS III Work Programme 2019 - 2025 are developed and promoted university network is designed to stimulate academic mobility, in particular, regional student mobility i.e. joint programs in the frame of CII HR 108 network leading up to double i.e. joint degrees and joint thesis supervision and planned mobility actions will be set in that direction. Planned mobility actions are going to be equally stressed on joint programs on all academic levels with the workload for teachers in the sense of at least six teaching or supervising hours a week at the host university in accordance with CEEPUS III Agreement.

We have finalized our curriculum and we were preparing common teaching materials in the frame of a curriculum on the level of BSc, MSc and PhD. We unified the methodology of the modern industrial practices, educational-technological knowledge, and curricula. Successful connecting the educational-technological knowledge with the modern industrial praxis and the important topics in an industry in the frame of our joint curricula. On the level of the joint program, a strong industrial collaboration of the majority of project partners enabled high educational level. Specialization of each project participant and its implementation into the new joint curriculum. Determining of the optimal structure of the curricula enable set-up of Joint Degree Diplomas, issued by partner universities in participating EU countries. Only with such kind of interdisciplinary educational knowledge and multilateral co-operation among universities the European engineers will be sufficiently innovative and enough competition to successfully implement the Lisbon declaration and the Bologna curriculum process, Education and Training 2020 strategy (ET2020) and Europe 2020 strategy. Through this network we have coordinate our network activities in line with three of five key priorities according to the Education and Training 2020 strategy (ET2020): improving the quality and relevance of teaching and learning, promoting mobility of students and staff and cross-border cooperation and strengthening the "knowledge triangle", linking education, research, and innovation. The curricula of our joint program set up in the frame of the presented CEEPUS network qualify students to work with modern computer aided environments, link their particular technological knowledge into a strong and powerful base for fast, reliable and competitive engineer work in the industrial environment. The mobility activities are planned to follow the main strategy of proposed network regarding our joint programs where the topics about integral product and technology development are integrated into the curriculum of all project partners. Different levels of integration follow the guidelines of the Bologna curriculum and of the Education and Training 2020 strategy (ET2020) process on the undergraduate and postgraduate level of our CEEPUS network. Students at all levels will be enabled the laboratory work and access to the workstations with different tools for effective use of CAE, AI and advanced modelling HPC (high-performance computing) environment. Exchange of experiences among undergraduate students, Ph.D. students and university teachers in the area of joint programs in accordance with CEEPUS III regarding modern information technologies in education and science is planned to be continued. Consultations for MSc and Ph.D. students with an academic staff of hosting universities in accordance with at least six teaching or supervising hours are also planned mobility action. Participation of incoming students and teachers on lectures and lessons in host university, cooperation at the diploma thesis and Ph.D. thesis, lectures of visiting teachers for students in the host institution. Preparation, development, and elaboration of a joint program for master and Ph.D. study in

the area of the joint program. Preparation of books, scripts, lectures in the English language according to the joint program will be continued. Implementation of e-learning, information, knowledge, participation to the common research activities, laboratory work in a frame of network investigations, lectures, seminars, summer courses and also participation to the scientific conferences and workshops organized by network partners are planned to be continued.

**As a pilot model will be introduced firstly BSc joint degree, which it will be followed MSc degree. This pilot study initially will be introduced by following new partners in the network Croatian Catholic University and Pázmány Péter Catholic University.** In 2018. we have been making procedural and organizational preparations for joint diploma agreements, this is for project preparation for application at EU social funds grants for internationalization of the university studies supported by Ministry of education and science Croatia. **It is important to note that in 2021. we have submitted joint degree for official accreditation, and we plan to start program in academic year 2022/23.** This pilot study initially will be introduced by following new partners in the network **Croatian Catholic University** and **Pázmány Péter Catholic University**. This activity it is supported by European Social Fund project *“Development of a joint graduate study of software engineering at the Croatian Catholic University and the Pázmány Péter Catholic University in Budapest”*.

This model is planned to be in latter development introduced between other interested partners of the CEEPUS network.

#### **Network partners:**

The proposed academic network consists of 23 partners from 12 countries:

- University of Rijeka, Faculty of Engineering, Croatia /as a network coordinator/
- University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Croatia
- University of Zilina, Faculty of Mechanical Engineering, Slovak republic
- Poznan University of Technology, Institute of Mechanical Technology, Poznan, Poland
- Kielce University of Technology, Department of Machinery Design, Poland
- Czech Technical University, Faculty of Mechanical Engineering, Prague, Czech Republic
- VSB- Ostrava Technical University of Ostrava, Faculty of Mechanical Engineering
- Tomas Bata University in Zlin, Faculty of Technology, Czech Republic
- Technical University of Cluj-Napoca Department of Engineering and Technologic Management
- University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia
- University of Ljubljana, Faculty of Mechanical Engineering, Slovenia
- Vienna University of Technology, Faculty of Mechanical and Industrial Engineering; Austria
- Budapest University of Technology and Economics, Faculty of Mechanical Engineering, Hungary
- University of Miskolc, Faculty of Mechanical Engineering, Hungary

- SS. CYRIL AND METHODIUS UNIVERSITY, Faculty of Mechanical Engineering, Macedonia
- University of Kragujevac, Faculty of Mechanical and Civil Engineering in Kraljevo, Serbia
- University of Kragujevac, Faculty of Engineering, Kragujevac, Serbia
- Technical University of Sofia, Faculty of Industrial Technology, Bulgaria
- Johannes Kepler University Linz, Austria
- University of Sarajevo, Faculty of Mechanical Engineering, Bosnia and Herzegovina
- J.J.Strossmayer University in Osijek, Mechanical Engineering Faculty in Slavonski Brod/as a new partner
- University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Textiles
- Faculty of Electrical Engineering, University of Montenegro, Montenegro
- Croatian Catholic University, Croatia
- Pázmány Péter Catholic University in Budapest, Hungary
- University of Nis, Faculty of Mechanical Engineering, Serbia
- "Angel Kanchev" University of Ruse, Faculty of Agricultural and Industrial Engineering, Bulgaria

## **Program**

The good basic knowledge of all manufacturing technologies from metal forming, machining, alternative manufacturing technologies, artificial intelligence, High Performance Computing, numerical simulations and modelling, measuring technologies as well as logistics and assembly is necessary to ensure companies sufficient technological level for competitiveness and innovation to survive on a large global market. But not only the knowledge and skill of particular field but also the capability of interdisciplinary use of all collected knowledge is of highest importance when new product is developed and the optimal technology is selected.

One of the general planned mobility actions is successful concluding all of agreements between network partners signed and stamped by University authorities regarding academic cooperation between faculties in the frame of this network including articles on preparation of joint programs of study and on making of joint diploma that will follow the guidelines of the Bologna process regarding the curriculum development on the undergraduate and postgraduate level will be planned for new partners. All those agreements are uploaded at prolonging of our network. This work will assure our joint program in master and Ph.D. level to be good adopted. One of the planned mobility actions is finishing the rest of common CEEPUS scientific books in the English language according to the joint program that will be used for master and doctorate level i.e. MSc and Ph.D. degree. All partners in our CEEPUS network HR-0108 Concurrent Product and Technology Development - Teaching, Research and Implementation of Joint Programs Oriented in Production and Industrial Engineering have taken a part in the CEEPUS scientific books with one or more chapters in the books on the classes connected on our joint program. Also, one special appendix in the books is made to be information about our possible thesis and our laboratories where our students and

short-term students could do their MSc. and Ph.D. thesis connected on the joint program. First, in a series of CEEPUS books oriented on our network are printed and other ones will follow.

Also, one of the planned mobility actions is preparing of the science report of HR 108 network for each year containing the papers of our common research in the frame of our network. A lot of our common papers in the area of joint program and joint research are published in the most famous scientific journals (CC, SCI indexed) and each one contains acknowledgment to CEEPUS and these activities will be promoted and continued. Also, one of the important planned mobility actions is implemented joint thesis supervision (master and doctoral thesis) in the frame of the network. In our network, joint thesis supervision (master and doctoral thesis) at more supervisors is excellent developed and in that way we are doing a Ph.D. thesis between our partners in our network.

Also, from 2009 our NCO supports us to organize summer school in June/July Rijeka. Also we organize CEEPUS scientific workshops on the margins of the famous international scientific conference started from 2010: September 2010 in Prague, September 2011 in Bratislava, September 2012 in Rijeka, September 2013 in Budapest, Leira (Portugal), September 2014, Dubrovnik September 2015, Prague September 2016, Ljubljana 2017, Zagreb 2018, Rijeka 2019, Rijeka 2020 (hybrid model). Last year 2021, we have organized online summer school as a pilot project due to pandemic situation, as a part **of RI-STEM student conference. Due to reason that was largely successful it is planned in cooperation with Student association of Faculty of Engineering UNIRI in 2023.** This online summer school will be followed by students from other partners in the network. Each summer school and CEEPUS scientific workshop is followed by book of CEEPUS workshop proceedings. Also, our planned mobility action is supported by means of online platforms, MS Teams. We are using e-learning by means of moodle in order to improve quality of our network (see: <http://moodle.srce.hr/course/category.php?id=110>). Also, during 2011/12 year the special web portal for CEEPUS CIII HR 108 is implemented and additional functionalities were been implemented till now and in 2022/23 additional features are going to be implemented for support of advanced collaboration and management. Special short-term excursion in accordance with CEEPUS III is planned in 2022/23. In last year's we have included new partners from Slovenia and Montenegro. This year we will expand the network with new partners from Bulgaria, because we want to strength our coordination and to develop and finalize procedures for joint diploma degree.

During 2018. we have been making procedural and organizational preparations for joint diploma agreements, this is for project preparation for application at EU social funds grants for internationalization of the university studies supported by Ministry of education and science Croatia. **It is important to note that this year as a pilot model will be introduce firstly BSc joint degree, which it will be followed MSc degree.** This pilot study initially will be introduced by following new partners in the network **Croatian Catholic University** and **Pázmány Péter Catholic University**. This activity will be supported by European Social Fund project ***“Development of a joint graduate study of software engineering at the Croatian Catholic University and the Pázmány Péter Catholic University in Budapest”***. This model is planned to be in latter development introduced between other interested partners of the CEEPUS network.

Additional activities are: Implementation of knowledge about modern CAE, AI and HPC environment in graduate and postgraduate studies. Aspects of modern conventional and non-conventional production technologies in education and science. Exchange of all level of students (graduate and postgraduate) as well as the university teachers will enable the dissemination of the knowledge in the field of manufacturing technologies. Scientific conferences and workshops where teachers, postgraduate

students will present their work. Scientific conferences and journals where the best diploma works will be presented to encourage students for scientific work . Taking part in diploma examinations (MSc, PhD). Taking part in postgraduate studies (MSc, PhD). Improvement of language skills on all levels of the academic population (students and teaching staff). Courses on measuring digitizing devices, Courses on CNC machines, Courses of the advanced modelling and Artificial intelligence. Finishing of the MSc and PhD thesis at hosting universities. Assistance with work on a diploma and doctoral thesis. Participation of hosted teachers at MSc and PhD defense as member of defendant board or co-mentor. Participation of incoming students and teachers on lectures and lessons in host university. Student Workshops. Also, using of E-learning in network tasks and in that purpose online training course on LMS Moodle system.

The network coordinator and the partner involved in the project have established a working agreement at the beginning of the academic year. It contains the objectives of the activities, the responsibilities of each partner and deadlines. Partially valuation will be realized on the end of winter and summer term by internet, e-mail discussions, during individual visiting of partner institution. The workshops (optional Conferences) will be organized with participants from partner institution. It gives opportunity to discuss, monitor and improve the performance of network. We monitor our progress through mutually conversation of CEEPUS partners, seminar works, experimental and laboratory works, traffic sheet, etc.

The objectives of curricula harmonization are to divide into two sections - short term and long term ones. The short term objectives are:

- To identify, compare and correlate the SMART specializations among as many partner faculties/departments as possible to better know and understand the possibilities and needs of each partner's university as well as of the industrial environment in each participating country.
- Determination of particular courses offered in shortest possible time as a joint program under the CEEPUS III framework. Determination of activities which are to implement in already presented activities of all project partners. The co-operation on seminar and diploma works, experimental studies, short courses, summer schools is already partially presented in an in-formal or formal inter-faculty cooperations.
- To create documents regarding joint programs among the project partners on institutional levels. These co-operations are to expand also on the educational level to arrange also the joint programs for the MSc and PhD courses, laboratory research work, papers publications and thesis supervisions (two such programs are already started)
- Expand the cooperation of partners on other national, industrial and technical projects
- After the verification of curricula harmonization is performed the long-term goals of the presented network are to establish:
  - Determining of the optimal structure of the curricula enabling the set-up of Joint Degree Diplomas, issued by partner universities in participating UE countries. Prerequisite for that is full adaptation of the Bologna process of all participating universities.
  - The project partners set-up a joint Program with emphasis on the Concurrent Product and Technology Development, based on new developed curricula according to the Bologna process. This curricula transformation is already performed or in progress by all participating faculties.

- Continuous evolution of determined joint program will follow the goal to educate high professional engineers for the entire European workforce area

## **PLANNED ACTIVITIES**

### **Planned mobility actions**

According to CEEPUS III Work Programme 2019 - 2025 are developed and promoted university network is designed to stimulate academic mobility, in particular, regional student mobility i.e. joint programs in the frame of CII HR 108 network leading up to double i.e. joint degrees and joint thesis supervision and planned mobility actions will be set in that direction. Planned mobility actions are going to be equally stressed on joint programs on all academic levels with the workload for teachers in the sense of at least six teaching or supervising hours a week at the host university in accordance with CEEPUS III Agreement.

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Taking part in postgraduate studies (MSc, PhD). Improvement of language skills on all levels of the academic population (students and teaching staff). Courses on measuring digitizing devices, Courses on CNC machines, Courses of the advanced modelling and Artificial intelligence. Finishing of the MSc and PhD thesis at hosting universities. Assistance with work on a diploma and doctoral thesis. Participation of hosted teachers at MSc and PhD defense as member of defendant board or co-mentor. Participation of incoming students and teachers on lectures and lessons in host university. Student Workshops. Also, using of E-learning in network tasks and in that purpose online training course on LMS Moodle system.

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## **SPECIAL CONTRIBUTION OF EACH INSTITUTION**

University of Rijeka, Faculty of Engineering:

Area of expertise:

- Numerical and stochastic modelling of production processes
- Optimization of production processes
- Production philosophy, revitalization and modernization of production
- Experimental design
- Computer data acquisition
- Controlling and inspection of processes
- Measuring and instruments for measuring
- Flexible Manufacturing System
- Calibration of measurement devices
- Advanced modelling by support of the HPC

Special contribution topic: NONHOMOGENOUS YIELDING AT SHEET METAL, MEASURING AND DIGITIZING METHODS, ADVANCED MODELLING

Special laboratory equipment:

1. Cyclone series 2- scanning and measuring machine
2. PCE RT 1200 roughness tester
3. PCE RT 1100 roughness tester
4. PCE-353 sound level indicator
5. PCE-2000 (type D impact) hardness tester
6. PCE-FM1000 force meter
7. PCE-OM 15 stroboscope
8. Leica Disto A6- laser measuring device
9. Hydraulic excenter press KNUTH
10. BURSTER Torgue gauge

11. ABB Robot IRB 120-3/0,58 EDU

12. ATOS Triple Scan

University of Ljubljana, Faculty of Mechanical Engineering, Slovenia:

Area of expertise:

- Metal and non-metal forming
- Powder injection moulding
- Computer aided process planning
- Computer aided process optimisation
- Numerical simulations with Abaqus and PamStamp programs
- Material testing for metals and non-metals
- Experimental work with hydraulic and ex-centric press
- EDM and water jet machining
- Non-conventional forming methods
- Experimental work with injection moulding machine
- Assembly and logistics.

Special contribution topic: DETERMINATION OF FORMING LIMIT DIAGRAMS

Special laboratory equipment:

1. X-Y measuring table with CCD camera
2. System for contact-free tensile test
3. Mechanic excenter press INDOP
4. System for injection moulding
5. Bosio Laboratory Oven
6. Double stroke hydraulic press LITOSTROJ HUO-2-250-400
7. System for FLD determination according to the Marciniak method
8. Universal testing machine AMSLER

University of Novi Sad, Faculty of Engineering:

Area of expertise:

- Formability problem in bulk metal forming, forming limit curves, methods of analysis of formability problem, influence of different parameters on material formability such as geometry of the die and billet, process conditions, etc.
- Cold bulk metal forming, mainly extrusion (theoretical and experimental investigation of main process parameters, process limits, tool stressing, material flow)
- Contact stresses in extrusion, upsetting and forging, development of special devices to measure contact stresses
- Visioplasticity investigation in bulk metal forming
- Spinning, wire drawing, fine blanking

Special contribution topic: BUKL (MASSIVE) METAL FORMING - THEORETICAL INVESTIGATION WITH EXPERIMENTAL VERIFICATION

Special laboratory equipment:

1. Special presses
2. Machines for metal forming

University of Miskolc, Faculty of Mechanical Engineering:

Area of expertise:

- The use of Factorial Experimental Design for the analysis of the effect of technological parameters on different parameters (as tool life, cutting force and torque, quality of machined surfaces, etc.)
- Development and application of new environment-friendly lubricants in metal forming
- Examination the difference among dry machining and the machining when there are usage of different coolants and lubricants with different volumes.
- Application of different rapid prototyping methods for rapid product development and machining

Special contribution topic: EXAMINATION OF METAL CUTTING AT ENVIROMENTALLY FRIENDLY MACHINING

Special laboratory equipment:

1. Metal cutting machines
2. Metal cutting equipment
3. Measurement equipment regarding metal cutting

Poznan University of Technology, Faculty of Mechanical Engineering:

Area of expertise:

- Manufacturing and operating of tools.
- Manufacturing and operation of gears and drives.
- Computer aided process planning
- New trends in technology: nanotechnology, rapid prototyping, rapid tooling, high speed cutting, environment friendly technologies
- Burnishing of machine elements

Special contribution topic: METHODOLOGICAL ASPECTS OF OBTAINING THE REQUIRED ACCURACY OF SPIRAL TEETH OF BEVEL GEARS FINISH MACHINING OF CYLINDRICAL GEARS ON CNC MILLING MACHINES

Special laboratory equipment:

1. Robotized assembly-machining workstation with industry robots IRp-6
2. Educational robots: L-2, Romik, ARM-1
3. Ergonomic assembly workstation of BOSCH GmbH
4. Automated workstation of modular assembly equipped with manipulators NM-3M
5. HERMALERT T4AHTCF4 - ALBRON (USA) – equipment for no contact temperature measurement
6. Stand of measurement adhesion force using the estimation of acoustic and vibration signal
7. Stereo-scopie and metallographic microscope
8. Layer meter

Kielce University of Technology, Department of Machinery Design, Poland:

Area of expertise:

- Metrology in machinery design

- Industrial measuring systems
- Computerisation of measurement and evaluation of control data
- 3D measurement using measuring robots and machines
- Methods for GPS measurement
- Methods for measurement and assessment of electrical signals
- Electrical methods for measurement of mechanical quantities
- Electrical and electronic metrology
- Measuring sensors and transducers

Special contribution topic: INVESTIGATION ON ACCURACY OF ROUNDNESS MEASUREMENTS BY THE REFERENCE METHOD

Special laboratory equipment:

1. Eclipse 550 - coordinate measuring machine
2. Computer-aided device for precise roundness&cylindricity measurements Talycenta
3. Computer-aided device for roughness, waviness and straightness measurements Talysurf 4Computer-aided device for precise roundness measurements Talyrond 73
4. Computer-aided device for precise roundness&cylindricity measurements Talyrond 200
5. Computer-aided device for roughness, waviness and straightness measurements Talysurf 4
6. Mobile device for roughness, waviness and profile measurements Hommel Tester T1000
7. Mobile device for precise roundness measurements PSA 4
8. Measuring device for inspection of dial gauges
9. Model measuring device V-block cylindricity measurements
10. Universal length measuring machine Ulm Opal 600

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

Area of expertise:

Using computer simulation for: determine material properties such as grain size, determine local hardness, predict material damage, predict phase changes and composition, simulate the influence of material selection, reduce time to market and cost of tool development, predict influence of process

parameters, reduce productions cost product quality, improve product quality, better understanding of material behaviour, reduce material waste.

University of Zilina, Faculty of Mechanical Engineering:

Area of expertise:

- New technologies in automobile industry
- Preparation for the modern superstructure of present engineering production
- Automated technique applications
- Computer-aided manufacturing systems
- The design and project of control systems for various technologies

Special contribution topic: CA SYSTEMS - TOOLS FOR INCREASING THE PRODUCTIVITY AND FLEXIBILITY OF ENGINEERING ACTIVITIES

Special laboratory equipment:

1. Diagnostics of CNC machines with QC 10 Ballbar
2. Calibration with laser interferometer system XL80
3. Interferometer system

Czech Technical University in Prague, Faculty of Mechanical Engineering:

Area of expertise:

- Elimination or minimization of wear
- Measurements of functional pairs of materials
- Measurements of values of the sliding friction coefficient for different materials
- Surface engineering
- Investigations of tribological properties

Special contribution topic: GREASE DETECTION AFTER CLEANING PROCESSES BEFORE APPLICATION OF SURFACE TREATMENT

Special laboratory equipment:

1. 2D, 3D visualization and measuring of surface structure with high resolution on laser confocal microscopy Olympus LEXT 3000
2. Hardness and micro-hardness measuring equipment
3. Friction measuring equipment
4. Metallography measuring equipment
5. Measurement of weldments defects equipment

Tomas Bata University in Zlin, Faculty of Technology, Czech Republic:

Area of expertise:

- Design and manufacturing of tools
- Computer aided manufacturing
- Nanotechnology
- Rapid tooling
- Environment friendly technologies
- Rapid prototyping

Special contribution topic: THEORY, SIMULATION AND RESULTS OF HIGH-SPEED GRINDING PROCESS

Special laboratory equipment:

1. Mitutoyo SJ-301 roughness tester
2. HPE II hardness tester manual, digital
3. HWT C-442 CNC Profi - MILLING MACHINE
4. BRH 20.03 F- GRINDING MACHINE
5. ZWICK 1456 - UNIVERSAL TESTING MACHINE
6. FORMEX 3000X – Vacuum forming machine
7. Specialized CAD/CAE/CAM software's

Budapest University of Technology and Economics, Faculty of Mechanical Engineering:



Area of expertise:

- Manufacturing technology
- Process measurement, process monitoring
- Cutting processes, ultraprecision machining
- Robotics, assembly automatization
- Data processing, artificial intelligence

Special contribution topic: MODELLING IN METAL CUTTING THEORY

Special laboratory equipment:

1. Metal cutting machines
2. Metal cutting equipment
3. Measurement equipment regarding metal cutting

Vienna University of Technology, Faculty of Mechanical and Industrial Engineering:

Area of expertise:

- Automation
- Automation of measuring
- Intelligent system
- Industrial robotics

Special contribution topic: INTEGRATION OF SUBORDINATION AND SELF, ORGANISATION IN WORKING SCENARIOS OF, BIONIC ASSEMBLY SYSTEM

Special laboratory equipment:

1. Software for Industrial robotics
2. Software bionic assembly system
3. Equipment for automation
4. Intelligent system

VSB- Ostrava Technical University of Ostrava, Faculty of Mechanical Engineering:

Area of expertise:

- machining of heavy machinability materials
- machinability of new construction materials
- test of tenacity materials at interrupted cut
- test of tenacity cutting materials with high fragility
- study of cutting power superhard materials
- study of properties surface layers
- experimental study of machining suit
- simulation of feed turning by temperature indication
- simulation of surface grinding by temperature indication
- dependability of tool machines
- application of CAD/CAM systems at machining

Special contribution topic: DETERMINATION OF CERAMIC MATERIALS, MECHANICAL PROPERTIES BY USING OF INDENTANT TECHNIQUES

Special laboratory equipment:

1. CNC Machinetool EMCO PC Mill 155
2. CNC Machinetool EMCO PC Turn 120
3. PYROMETHER with PC output
4. Surface Roughness Tester Mitutoyo SJ400
5. Neophot II
6. Microscope INTRACOMICRO
7. Device for Length Measuring ULM 450

Technical University of Cluj-Napoca, Department of Engineering and Technologic Management:

Area of expertise:

- Computer aided process planning
- Technology of gears
- Operation of machines
- Logistics of small and medium companies
- Material processing technologies
- Management

Special contribution topic: COMPUTER AIDED PROCESS PLANNING

Special laboratory equipment:

1. Metal cutting equipment
2. Software regarding process planning
3. Machines for processing of gears
4. Production Engineering measurement equipment

University »Sts.Cyril and Methodius«-Skopje, Faculty of Mechanical Engineering, -Skopje-Republic of MACEDONIA:

Area of expertise:

- Automation in Production Technologies
- Computer Numerical Control and CAD/CAM systems
- CNC machine tools, Parallel Kinematics Machines and Industrial Robots
- Accuracy of CNC Machine Tools

Special contribution topic: THEORY, SIMULATION AND RESULTS PRECISION MACHINING AND PROTOTYPING

Special laboratory equipment:

1. CNC milling machine
2. Double Ball Bar measuring equipment
3. Industrial robot

#### 4. Rapid Prototyping machine

University of Kragujevac, Faculty of Civil and Mechanical Engineering Kraljevo

Area of expertise:

- Quality control
- Maintenance & reliability
- Rapid prototyping/manufacturing/tooling by selective laser sintering -Reverse engineering

Special contribution topic: RAPID PROTOTYPING/MANUFACTURING AND REVERSE ENGINEERING

Special laboratory equipment:

1. EOS INT M280 machine for selective laser sintering of metal
2. EOS Formiga P100 machine for selective laser sintering of plastics
3. ATOS Compact Scan 3D scanner

Technical University of Sofia, Faculty of Industrial Technology

Area of expertise:

- Increasing the durability of cutting tools by preliminary energy impacts
- Electrophysical technology for durability enhancement of ferromagnetic materials
- Unconventional methods and opportunities to influence the process variable cutting material.

Special contribution topic: ANALYSES OF DURABILITY OF MATERIAL, ANALYSES AND MEASUREMENTS OF VARIABLE OF CUTTING MATERIAL, ENHANCEMENT OF DURABILITY OF FERROMAGNETIC MATERIALS

Special laboratory equipment:

1. Machine for laser micro- process- "Lasertec 40"
2. Machine for micro prototyping- "Solidscape R66"
3. 3D scanner – "Nextengine".

Johannes Kepler University Linz

Area of expertise:

Electrical drive engineering; mechanical, electrical and magnetic design of small and middle power range electrical drives, mechatronic system integration, research of new drive topologies, FEM drive optimization

Magnetic bearing technology; research and development of magnetically levitated drives, design of magnetic bearings and bearingless slice motors, drive optimization for industrial applications, control theory of levitating drives

Development tools; development of a simulation and optimization software for electrical drives and magnetic bearings, Genetic algorithm optimization, FE-simulation for parametrized 3D drive models, development of the M2C (Matlab® to C-Code) system for automatized implementation of graphical control schemes into fixed point DSP

Special contribution topic: GENETIC ALGORITHM OPTIMIZATION, FE-SIMULATION FOR PARAMETRIZED 3D DRIVE MODELS, MECHATRONIC SYSTEM INTEGRATION, FEM OPTIMIZATION

Special laboratory equipment:

1. 4x dSpace Systmes ACE 1103 (with several extension boards)
2. Board net emulation NNBM 8125
3. Two line V-network 9kHz-30kHz
4. Magnetization device M-Pulse 3k30sde
5. Test rig for electric machines up to 5kW (with equipment)
6. Test rig for electric machines up to 50kW (with equipment)
7. Digital Power Meter Yokogawa WT1600
8. Acoustic noise absorption chamber SONATECH PUR SINUS 50 SK
9. Leonard set (coupled DC- and induction machine) 60kW 400A
10. Several power electronics (e.g. 10kW 400V 400A)
11. Measurement system for magnetic parameter (up to 2kHz, 2kW)
12. EMC test equipment
13. Vibration measurement system (shaker, celerometer, data aquisition from NI)
14. Temper device Tempro basic C140
15. channel telemetry system TMS T1-PCM-IND
16. Selection of handling/tooling equipment
17. Band-saw PROXXON MBS 230-E
18. Balancing machine (for small rotors)
19. Precision scale PCE-LS 500

20. compactor 20t
21. Table milling machine PROTOMAT 95SII
22. Coil winding machine
23. ultrasound cleaning device T570H

University of Sarajevo, Faculty of Mechanical Engineering Department for Mechanical Production Engineering:

Area of expertise:

Manufacturing Machining technologies with and without removing particles with CNC control

Modelling and simulation of dynamic (mechatronics) systems (by bond graph, using BondSim, Matlab, Dymola, etc.)

High speed machining, Nonconventional machining, Industrial robot programming, Modelling and simulation using Finite Volume Methods, Metal materials, Welding processes,

Special contribution topics: MODELING AND SIMULATION OF MECHATRONICS SYSTEM, EXPERIMENTAL AND NUMERICAL ANALYSIS SOME PARAMETERS TO QUALITY OF LASER CUTTING OF MATERIALS

Special laboratory equipment:

1. ABB robot IRB 1600
2. Mobile robot ROBOTIONO
3. Robot Mitsubishi RV-M1
4. Electropneumatic equipment set for closed loop analysis
5. NC lathe Emco Compact 5
6. NC milling machine Emco F1
7. Work-table equipped with pneumatic and electric engines, controlled through PLC – S7 200 and S7 300
8. „Pick and place robot“ with control via SIEMENS PLC S7 300
9. High speed motor spindle: HS type HSM 090-40000
10. Electromechanical drive with: INDRAMANT engines

11. Direct drive with linear SIEMENS engines
12. Direct drive with SIEMENS servo engines

J.J Strossmayer University of Osijek, Mechanical Engineering Faculty of Slavonski Brod, Department for Production Engineering:

Area of expertise:

Polymer processing technology (especially injection moulding), polymer materials testing, processing and application of polymeric nanocomposites, additive manufacturing technologies (rapid prototyping and rapid tooling), adhesive bonding technology, non-traditional machining procedures (high-speed machining, abrasive jet cutting, laser cutting, and smoothing), ecologically acceptable machining procedures and traditional machining procedures, metal casting technology, metal forming technology, numerical simulations, finite element analysis (FEA), welding technology and processes (LaserHybrid welding, MAG-STT welding, CMT process, FastRoot process and plasma welding), surface material protection technology, integrated management systems.

Special contribution topics:

Modelling and simulation of injection moulding process, development and optimization of the spatial structures for a 3D print, medical applications of additive technology.

Special laboratory equipment:

1. Ultrasound measuring instrument for the control of parent material and welded joints homogeneity
2. Re-condensation strength measuring device DISA PNZ
3. Residual stress measuring device HBM MTS3000
4. Solid Cast software for simulation of metal casting
5. Universal lathe TNP 160 A
6. Band saw
7. Electro-erosion tool machine
8. Devices and equipment for acquisition and measuring technological process parameters,
9. Device for measuring wear of the tool cutting edge
10. Device for controlling the driving engine on tool machines,
11. Device for simulation of the tool cutting edge sharpening

12. Injection moulding machine Dr.Boy XS
13. Temperature control unit Regloplas 90S
14. Plastic pellets dryer Moretto D1T
15. Injection mould for manufacturing of ISO 527, ISO 178 and ISO 179 specimens
16. Tensile testing machine Shimadzu AGS-X
17. High precise scales Radwag PS600 R.2
18. 3D colour printer Mcor Iris
19. 3D printer ZPrint 310
20. 3D scanner Artec Eva
21. Tripod CNC machine tool OrtoMach
22. Stereo-photogrammetry scanning device OrtoScan
23. Autodesk Moldflow Adviser software for simulation of injection moulding of polymers
24. Software for processing of medical images 3D Doctor
25. Six axis industrial robot for MAG/MIG welding with robotic welding positioner Motoman
26. Apparatus for MAG/MIG and TIG electric arc welding by impulse current TPS 2700
27. AC/DC apparatus for REL and TIG welding by impulse current MagicWave 2000
28. DC apparatus for REL and TIG welding by impulse TT 1600
29. DC MAG/MIG conventional welding apparatus
30. AC/DC conventional REL and TIG welding apparatus
31. On-line monitoring system for electric arc welding processes
32. Spot electric resistance welding device
33. Automatic tracking vehicle FTV 4 with remote control unit FCU-4-RC
34. Apparatus for air plasma cutting Hypertherm Powermax 1250
35. Apparatus for thermal spraying and cold spraying Castolin Rotec 80
36. Implant apparatus for steel weldability testing
37. Equipment for stud arc welding
38. Equipment for testing of materials and protective coatings in salt and wet chamber
39. Off-centre 50-ton press
40. Gravitational hammer



41. Various tools for punching, bending, deep drawing and forging

University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Textiles, Graphic Arts and Design, Slovenia:

Area of expertise:

- Conventional, digital and 3D printing
- Substrate characterisation and print quality assessment: spectroscopic and microscopic methods, image processing/analysis
- Functional printing and printed electronics
- Automatic identification technologies: barcodes and 2D codes, radiofrequency identification (RFID)
- 3D modelling and animation
- Microencapsulation
- E-learning
- Scientific and technical informatics

Special contribution topic: prepress, press and postpress operations, graphic materials, printed electronics, packaging, image processing, information-communication technologies, photography, 3D modelling, colorimetry, typography, graphic design and ecology.

Special laboratory equipment:

1. Absorption UV-VIS spectrophotometer Cary 1E
2. TOC Shimadzu TOC-5000A
3. Air permeability tester Air-Tronic B
4. DMA Q800 Dynamic Mechanical Analyzer
5. Tensile testing machine - Instron 5567
6. FT-IR spectrometer
7. Gyrowash 815
8. Laboratory Jet JFL and Lab Jumbo Jet JFO
9. Laboratory padder
10. Martindale Wear & Abrasion Tester M235

11. Flat knitting machine SES 122RT, gauge 12E
12. Cutting machine Wohlenberg 76

Faculty of Electrical Engineering, University of Montenegro, Montenegro:

Area of expertise:

High-quality fundamental and applied research and education mostly in the field of Multimedia representing the future of modern life. The research has been also conducted within several related fields, such as radars, communications, biomedical signal analysis and applications, closing a circle of state-of-the-art technologies.

Special contribution topic: Develop innovative techniques for generalized signal processing, Develop advanced techniques for time-frequency signal analysis, filtering and classification, Develop the algorithms for multimedia signals processing: audio, image and video processing algorithms, Develop the algorithms for multimedia data protection - Digital Watermarking, Contribute to the theoretical foundation of modern Compressive Sensing concepts, Develop the innovative techniques for Compressive Sensing data reconstruction.

Special laboratory equipment:

1. pH Meter XS PH50
2. Oscilloscope Tektronix DPO4104
3. Oscilloscope Agilent U1640A
4. Oscilloscope Agilent MSO6012A
5. Oscilloscope Agilent DSO3120A
6. Multi place stir/hot plate 4 place THERMO SCIENTIFIC SUPER-NUOVA MULTI POSITION
7. HPLC Shimadzu Nexera XR
8. Vector signal generator Stanford Research Systems SG 396
9. Universal Counter Agilent 53220A
10. Test set ZTEC ZT8201, ZT 8651, ZT 8751
11. Signal Analyser Aeroflex 3252

Faculty of Mechanical Engineering, University of Kragujevac, Serbia:

Area of expertise:

High-quality fundamental and applied research and education mostly in the field of Integration of companies and modeling of business processes, Computer aided design, planning and production and Computer controlled production technology. The research has been also conducted within several related fields, such as Quality management in CIM environment, Integration systems and methods and Management of CIM technologies.

Special contribution topic: Equipment of the Laboratory with machines, devices, kits, measuring chains, measuring instrumentation, modern computer systems and other devices, provides the research in great number of scientific disciplines like: Metal machining, Machine tools, Tools and kits, Tribology, Maintenance of technical systems, Design of technological processes (CAD/CAM), Metrology, processing of plastic masses, Non-conventional machining procedures, Quality and product's quality management . Modern measuring chains for measuring of cutting resistance (KISTLER) and cutting temperature (with natural and artificial thermal couples), of complex parameters of surface roughness (TAYLOR-HOBSON), of parameters of cutting tools' wear (microscopic and laser methods), of reliability of operation and service life of tools and machine elements, devices and mechanisms (model testing on tribometer), with complete computer support, create necessary conditions for realization of a large number of research programs.

Special laboratory equipment:

1. KISTLER
2. TAYLOR-HOBSON
3. Computerized measuring system for material testing ZWICK/ROELL Z 1004 .
4. Universal hydraulic triple acting forming press ERICHSEN 142/12

Croatian Catholic University, Croatia

The Croatian Catholic University is just establishing engineering science program and it will use network experience in that action. The network will use proposed model of program to be implemented with other interested partners. The undergraduate programme software engineering at the Catholic University of Croatia, which is designed to provide not only courses related to computer science as the core study programme, but, along with these, insights into the dynamics of social change in the modern world together with the ethical challenges that these changes bring. This relates, in particular, to cyberculture, understanding modern methods of communication, attitudes towards the body. The intention is to try to bridge the gap between different professions, i.e. to try to overcome the paradigm of science that was created in the 19th century that went towards the partialization of science and to creating a synthesis that will be scientifically fruitful and in practical terms will allow students to better communicate with potential employers and clients.

The graduate programme was conceived as a joint study programme together with the Peter Pazmany Catholic University in Budapest. The joint programme will enable the exchange of students and professors between the two universities, overcoming cultural differences and greater market access for the students who will attend this programme. Commencement of the joint software engineering graduate study programme of the Catholic University of Croatia and the Pázmány Péter Catholic

University, funded through the measure &quot;Internationalization of Higher Education&quot; of the European Social Fund, is planned in the academic year 2021/2022.

Pázmány Péter Catholic University, Faculty of Information Technology and Bionics, Hungary

Teaching and research competencies:

- Analysis and control of dynamical systems
- Cellular wave computing and kiloprocessor arrays
- Embedded vision systems
- High performance computing
- Implantable microsystems
- Microfluidics
- Natural language processing
- Sensory robotics
- Smart sensory computing
- Software defined electronics
- Spintronic and nanocomputing
- Ultrasound imaging

Special laboratory equipment:

1. 3D scanning 2-photon microscope for simultaneous electrophysiology and imaging measurements for in vivo neuroscience
2. Nikon Eclipse Ti2-E microscope
3. Singer Instruments MSM400 microdissection microscope
4. Full featured rapid prototyping setup
5. Hamilton Starlet liquid handling robot
6. Heidelberg Instruments uPG 101 direct laser writer for micromanufacturing
7. SPS MDA 400LJ mask aligner for precision microtechnology manufacturing
8. Tecan M20 multi-mode plate reader with temperature-controlled sample chamber and injectors
9. Blitz biolayer interferometer for the characterization of biomolecular interactions
10. UR5 collaborative robot arm
11. OnRobot 6 axis force torque sensor
12. high performance compute grid with 40 NVIDIA GPUs (2080 Ti compatible)

University of Nis - Faculty of Mechanical Engineering (MFN) ([www.masfak.ni.ac.rs](http://www.masfak.ni.ac.rs)) has more than 90 researchers in six main research groups: Mechatronics and Control group, Machine Design, Development and Engineering group, Production and information technology group, Transportation and Logistics group, Energetics and Process engineering group and Mechanics group. The Department for Mechatronics and Control has 8 teachers and 6 teaching assistants and 11 PhD students at the moment.

Four laboratories are part of the Department: Laboratory for electrotechnics; Laboratory for mechatronics; Laboratory for machine and mechanisms; Laboratory for control systems.

The group for Control systems has a lot of experience in Conventional control systems, AI techniques (ANN, Deep learning, GA, PSO, Fuzzy, ANFIS...) and their implementation in various areas, Industrial software development (MATLAB, LABVIEW, SolidWorks, Python, C++, Java...), Vision systems, Obstacle detection systems, Monitoring and measuring devices, Predictive maintenance, Fail safe systems, Decision support systems, Expert systems, Implementation of Optimization AI algorithms in business processes and deviations in decision making processes, SCADA (water supply and district heating companies), Short term prediction, Classification and pattern recognition, Robotics, Railway-freight transportation, Railway Logistics. All this experience was gained through successful realization of 2 H2020 projects, 2 Tempus, 3 ERAZMUS+ projects, numerous bilateral Serbia-Germany DAAD projects, 4 National Innovation projects, 5 National projects etc.

List of some of the laboratory equipment is as follows:

1. Hydraulic shaker (Electrohydraulic actuator)
2. dSpace ACE kit 1103
3. SIEMENS Academic Training Set PLC S7-1200 Bundle (PLC Siemens Simatic S7-1200 training set, 6 x PLC + Software + Cabling)
4. SIEMENS Academic Training Set PLC LOGO Bundle (PLC Siemens LOGO training set, 5 x PLC + Software + cabling)
5. SIEMENS Academic Training Set HMI KTP 600 Bundle (HMI Siemens SIMATIC Basic Panel KTP 600 for S7-1200 training set, 5 x Touch panel + cables + switches)
6. National Instruments NI USB-6009 and National Instruments NI myDAQ sets
7. Hydraulic press 100t
8. ROBED robot
9. NI Single-Board RIO DANI mobile robot (2 pcs)
10. National Instruments NI ELVIS II+ (3pcs)
11. Quanser QNET Rotary Inverted Pendulum Board, Quanser QNET HVAC System board, Quanser QNET VTOL 1DOF Helicopter Board, Quanser QNET DC Motor Control Board, Quanser QNET Myoelectric Trainer 781384-01 for NI ELVIS
12. LEGO Robotics Mindstorms NXT 2 Set (3pcs. - 619 elements LEGO technic, 1 NXT micro-computer, 2 Touch Sensors, 1 Ultrasonic Sensor, 1 Color Sensor, 3 Interactive servo motors with built-in rotation sensors, 7 connector cables, User Guide, software, Test Pad) + Set of additional sensors and cables for Lego Robotics Mindstorms (3x Gyroscopic Sensor, 3 x Sound Sensor, 3 x Connector Cables)
13. High speed camera Photon Fastcam SA6
14. Video conference system Polycom HDX 6000
15. Multiprocessor workstation specialized for performing engineering calculations Dell Precision T5600
16. Lab set for exercising and research in the field of design & analysis of control systems, measurements, virtual instrumentation and simulation, with mechatronic, mechanic and thermodynamic system models FESTO 544208

17. Lab set for training and research in the field of application of programmable logic controllers (PLCs), their modules and industrial control communication busses, with touch panels, elements of SCADA systems and various add-ons FESTO 54428
18. Modular production (mechatronic, training) system FESTO MODULAR MECHATRONIC KIT MPS® 205-Mechatronics
19. Laboratory set for education and research in the field of application and programming of industrial robots, which consists of industrial robot and simulated industrial environment, with software support included FESTO MPS SYSTEM
20. Thermal Camera FLIR E30
21. Laser Scanner For Weld Groove Tracing MICRO-EPSILON
22. Function generator 50MHz Thurlby Thandbar
23. Scanner for 3D measurement and inspection EFFEBI HDI ADVANCE R3(Скенер за тродимензионално мерење и контролу EFFEBI)
24. Ultrasonic Flowmeter GE PT-SYS-1-2-H-D-IO
25. Universal testing machine (tension, compression, bending), with accessories METROCOM 10407030
26. 1 x 3-axis positioning system PHYSIK M-403.62S
27. 40 modern computers in 3 classrooms
28. MATLAB software
29. NI LabView software

"Angel Kanchev" University of Ruse is an autonomous state higher school. There are eight faculties in the structure of the University: Agrarian and Industrial Faculty, Faculty of Mechanical and Manufacturing Engineering, Faculty of Electrical Engineering Electronics and Automation, Faculty of Transport, Faculty of Business and Management, Faculty of Natural Sciences and Education, Faculty of Law, Faculty of Public Health and Healthcare, two Branches of Ruse University in Silistra and Razgrad and a Bulgarian and Romanian Inter-university Europa Centre. Department of Heat, hydraulics and environmental engineering, Faculty of Agricultural and Industrial Engineering will participate with following activities.

Activity 1 covers the following fields:

- Studying of centrifugal pumps working with air-water mixtures;
- Studying the impact of trimming a centrifugal pump impeller on the pump energetic characteristics;

Activity 2 covers the following fields:

Establishing models and criterions for energy analysis of fluid transportation;

Establishing criteria equations for studying the energy efficiency of pump and fan systems, used transport fluids;

Studying the impact of environmental operating conditions on the energy consumption of fan systems;

Studying the impact of some key elements widely used in fan systems (diffusers, confusers, etc.) on the reduction of energy consumption in such systems;

Activity 3 covers the following fields:

- Hydraulic modeling of the energetic characteristics (operating curves) of hydrostatic pumps and motors;
- Studying of vane pumps in working with low viscosity liquids (water and water solutions);
- Studying of a three-rotor pump of the type of double-sided pipe engagement (patented).

### **Selection Criteria**

#### **Student mobility**

- We prepare students from our faculties through information CEEPUS course on the beginning of semester in order to plan the number of students that will go on exchange. Also, we prepare students by means of seminar works, experimental and laboratory works at faculty as well as the work with advance programs and methods at faculty which serve to improve student's skills and knowledge and to improve their language.
- Only extraordinary good students with sufficient number of credits, utilizing of ECTS system with emphasis on the field of joint program and with sufficient language level.
- Evaluation on the base of obtained ECTS/semester.
- Sufficient number of credits, utilizing of ECTS system with emphasis on the field of manufacturing technologies and multidisciplinary .
- Our CEEPUS network partners have a very good elaborated some specific scientific areas. Each of partners organizes the special activities regarding scientific topics of diploma thesis and also, in that way chose students.

#### **Short Term Student mobility**

Planned short term students mobility are more stressed on joint doctoral programs in accordance with CEEPUS III Agreement.

Our selection criteria for short term students include:

- Students with MSc or PhD topics better elaborated on partner institution and by means of our common e-learning course (very good study results - sufficient number of credits according to the ECTS system - high language level in the technical terminology).
- Students with determined MSc or PhD thesis
- In the frame of joint thesis supervision (Thèse en cotutelle-master and doctoral thesis) on the base of their mentors (teachers) agreements
- Very good study results
- Sufficient number of credits according to the ECTS system

- High language level (also in the technical terminology)
- ex CEEPUS students that have used CEEPUS program as ordinary students

### **Teacher mobility**

Planned teacher mobility are more stressed on joint doctoral programs with the workload for teachers in the sense of at least six teaching or supervising hours a week at the host university in accordance with CEEPUS III Agreement.

Our selection criteria for teacher include:

- Excellent scientific and educational skills
- Active interest in the presented professional field
- Common topics and courses that are supplementary among the network partners.
- Preparing of the elaborated university books on the joint program
- High level of communicativeness
- Very good language level
- Workshops organized by partners
- All contributing teaching staff participated on the network holding prescribed amount of lectures and courses
- Continuously development of the program of the planned joint programs on the bilateral as well as multi-lateral basis (number of: signed joint program agreements, joint research works and published papers and books).

### **Coordination**

#### **If yes, please specify intended frequency**

Through e-Learning free Learning Management System Moodle provided by Faculty organization SRCE-Zagreb we can hold meetings whenever we wish. It is possible to check this on web site:

<http://moodle.srce.hr/course/category.php?id=110>

The coordination meetings are planned four per semester with every partner involved in the project.

We organize every year CEEPUS summer schools and CEEPUS workshops and during these occasions (special summer school, conferences, workshops, etc.) coordination meetings are planned.

Also, regularly we will hold meetings more times per month.



Also, in 2011/12 year the special web portal for CEEPUS CIII HR 108 is implemented and in this portal, we are holding regular meetings, additional functions have been implemented during the project duration. In next year we will continue to improve this tool with advanced features.

Special winter and summer school was held in 2021/22 and during this school year coordination meeting are planned, the same type of activities are planned in the 2022/23 academic year.

### **How do you plan to monitor the performance of your network?**

In 2011/12 year our special web portal for CEEPUS CIII HR 108 is implemented and in this portal have a special part for monitoring of the performance of the network in the way that partners will be asked to fill up monitoring procedure. In 2012/13 year was implemented special features for measuring mobility and scientific achievements, in 2013/2014 we started integration with open source software for management and google services. In 2021/22 we will continue with integration and development of new collaborative tools.

Also, the network coordinator and the partner involved in the project establish a working agreement at the beginning of the academic year. It contains the objectives of the activities, the responsibilities of each partner and deadlines. Also, CEEPUS online system is excellently developed for monitoring mobility activities, applications, reports etc. Partially evaluation will be realized on the end of winter and summer term by internet, e-mail discussions, during individual visiting of the partner institution. The Workshops (optional Conferences) will be organized with participants from the partner institution. It gives the opportunity to discuss, monitor and improve the performance of the network. We monitor our progress through the mutual conversation of CEEPUS partners, seminar works, experimental and laboratory works, traffic sheet, etc. Also, in our CEEPUS network, we use e-Learning through free Learning Management System Moodle provided by Faculty organization SRCE-Zagreb and in that way we can monitor some activities in the network (joint diploma, MSc and PhD. thesis, joint research works, published papers and books) whenever we wish.

All contributing teaching staff participated on the network hold a prescribed amount of lectures and courses (one of the milestones). Besides this, they have meetings with people from the host university (not only from the host department) to ensure continuously development of the programme of the planned joint programs on the bilateral as well as multi-lateral basis (number of: signed joint program agreements, joint research works and published papers and books are also some of the milestones).

### **Recognition**

Additionally to the obtaining letters of Endorsement and letters of Intent following activities were carried out to successfully launch the developed network:

-Checking a partners curricula and ECTS in order to match them with network purpose oriented on joint programs.

-Contracts and agreements between partners (faculties in our CEEPUS network) has been made and signed (all of them) where we have ensured mutual recognition.

- One article in our contracts is: Institutions will work on preparation of joint programs of study and on creating of possibility to making of joint diploma that will follow the guidelines of the Bologna process regarding the curriculum development on the undergraduate and postgraduate level. Exchange of experiences between undergraduate students, postgraduate students and university teachers in area of joint programs would be possible in accordance with modern information technologies in education and science (it has been seen on our upload Documents relating to our Joint Programs).
- Contacts between all local coordinators and in some cases PPU deputies as well have been performed to spread relevant information about the CEEPUS networks.
- Every year we organize CEEPUS summer school and CEEPUS workshops in order to improve mutual recognition.
- Specific talks via e-mail or by phone have been held with the partners in order to elaborate the drafts of the Joint Agreements.
- Discussions about already presented cooperation outside of the CEEPUS organization on the educational and scientific field were held in order to fit that cooperation to the CEEPUS framework.
- Implementation of e-learning teaching activities using MOODLE learning management systems (see our site with our CEEPUS network involved in e-learning on :<http://moodle.srce.hr/course/category.php?id=110>)
- Set up of the structure of the joint curricula according to the Bologna process to intensify the inter-university connections and mobility as the main goal of the CEEPUS network.
- Monitoring of CEEPUS actions in order to apply them regarding mutual recognition (e.g. in accordance with CEEPUS III Agreement our network will be more stressed on joint doctoral programs with the workload for teachers in the sense of at least six teaching or supervising hours a week at the host university).

### **Special Merit**

Our CEEPUS network is combined with other programs and activities. In this way we can support our network regarding financial possibilities. Technological and other projects created by means of our CEEPUS PhD and MSc thesis help us to establish good link with industry and obtain more financial possibilities in order to organize preparing of teaching materials as CEEPUS books, summer and winter schools, workshops, etc. On the basis of this CEEPUS network 10 bilateral projects financed by National Ministry of Science and Education emerged and 3 have been financed. Also, a large number of technological projects are emerged. Now, we combine these programs and in this way also support our CEEPUS HR 108 network. Also, we combine our network with more than 30 national and technological projects. A lot of research activities will be financial supported by these projects. Also, partners local initiative in which takes part some industry enterprises. As the main coordinator is certified course designer in E-learning partners use advantages of E-learning. Implementation of e-learning teaching activities using learning management systems as Moodle is included in the network. In 2020/21 it was planned to increase cooperation using additional EU schemes, for reinforces the research cooperation and research infrastructure (ERASMUS, H2020, INTERREG, Structural funds, etc.). According to these activities, we have submitted 6 project proposals. **In this moment we have four EU financed project**

**between the partners: Science Center for Excellence in Data Science and Cooperative Systems; DATACROSS Project - Advanced Methods and Technology in Data Science and Co-operative Systems, CEKOM Smart city, and Erasmus+ project 2021-1-HR01-KA220-HED-000031177, „Introduction of joint short-style ICT courses for better employability of students and graduates (WICT)“.** The partners from CEEPUS actively are involved in 2 EU infrastructural project, and according to activities in the network we have submitted 5 Horizon 2020 proposals, and in plan we have 6 more in next academic year.

In 2018. we have been making procedural and organizational preparations for joint diploma agreements, this is for project preparation for application at EU social funds grants for internationalization of the university studies supported by Ministry of education and science Croatia. **It is important to note that in 2021. we have submitted joint degree for official accreditation, and we plan to start program in academic year 2022/23.** This pilot study initially will be introduced by following new partners in the network **Croatian Catholic University** and **Pázmány Péter Catholic University**. This activity it is supported by European Social Fund project *“Development of a joint graduate study of software engineering at the Croatian Catholic University and the Pázmány Péter Catholic University in Budapest”*.

In our CEEPUS network, we use e-learning through free Learning Management System Moodle provided by Faculty organization SRCE-Zagreb and in that way we use opportunities of e-learning. It is possible to check this on the website:

<http://moodle.srce.hr/course/category.php?id=110>

Also, some of the partners are involved in Erasmus, H2020, etc. projects and we use their experience connections and mobility as the main goal of the CEEPUS III network.

Also, we prepared our CEEPUS common books that served for our joint program and helps our MSc. and Ph.D. students. We have our common CEEPUS scientific books and scientific reports in the English language according to the joint program that uses for MSc and Ph.D. degree. Firsts in a series of CEEPUS books oriented on our network were printed and others are in working procedure. Our CEEPUS network partners have a very good elaborated some specific scientific areas. Each of partners organizes the special activities regarding scientific topics of MSc and Ph.D. thesis.

By means of CEEPUS we found out our teaching, research and equipment possibilities and we match them for many other programs and activities in order to help our CEEPUS network to be better.

### **Further Information**

We have created the network basing on the experience in networks participating (CEEPUS SK-108, PL-0033, RO-103, A-104, SK-030, BG-0722). Partners are from Hungary, Serbia, Czech Republic, Slovakia, Croatia, Poland, Austria, Slovenia, Macedonia, Romania, Austria, Bulgaria, Montenegro and Bosnia and Herzegovina. Most of partners have the scientific and teaching cooperation from more than 15 years. Also, at the same time we have used new possibilities of joint programs. In our network joint thesis supervision at Master and PhD. thesis at more supervisors is excellent developed and in that way we have done a lot of Master and PhD thesis between our partners in our network. This part of Joint Program is excellent worked out in the framework of our network.

We have a good developed and elaborated joint program for master study and PhD study in the frame of production and industrial engineering. **It is important to note** in 2018. we have been making procedural and organizational preparations for joint diploma agreements, this is for project preparation for application at EU social funds grants for internationalization of the university studies supported by Ministry of education and science Croatia. **It is important to note that in 2021. we have submitted joint degree for official accreditation, and we plan to start program in academic year 2022/23.** This pilot study initially will be introduced by following new partners in the network **Croatian Catholic University** and **Pázmány Péter Catholic University**. This activity it is supported by European Social Fund project ***“Development of a joint graduate study of software engineering at the Croatian Catholic University and the Pázmány Péter Catholic University in Budapest”***.

In the year 2007/08, we have new partners from Czech and Poland, in this year 2008/09 we have a new partner from Czech and in year 2010/11 we have included a new partner from Romania. Our next step it was to include new partners from Bosnia and Herzegovina and Macedonia (in 2013/2014 because we prepare agreements for joint doctoral programs). Due to collaboration with Macedonian and Serbian Universities, we are proposing as a new partners to be SS. CYRIL AND METHODIUS UNIVERSITY-Skopje-MACEDONIA, FACULTY OF MECHANICAL ENGINEERING and University of Kragujevac, Faculty of Mechanical and Civil Engineering in Kraljevo. Because of the increase collaboration activities for this we increase the number of the partners to Bulgaria (Technical University of Sofia), Bosnia and Herzegovina (University of Sarajevo), and we have added one more partner from Austria (Johannes Kepler University Linz). Also due to the expansion activities of the CEEPUS program, it was include Russian, Latvian and Estonian Universities as silent partners in 2013/2014, which give us additional value to our network with possible activation. In 2018/19 we have included University of Podgorica, Montenegro and additional institution from Slovenia. In 2019/20 we have introduce additional institution from Serbia. In 2021/22 we was introduce additional institution from Hungary, Croatia and Serbia, which will increase cooperation capacity of the network. This year we will expand the network with new partners from Bulgaria. Also, we have made all University agreements related on joint program signed by authorities in our network.

We have finished some of our common CEEPUS scientific books in English language according to the joint program that we use for MSc. and PhD. degree. We still work on our other CEEPUS books that will be used for our joint program. Our CEEPUS network partners have a very good elaborated some specific scientific areas. Each of partners organizes the special activities regarding scientific topics of Master and PhD thesis. In 2021/22 we will not increase members of network, to be able to increase cooperation capacity of the network.

Every year we will prepare the Science Report of HR 108 network containing the papers of our common research in the frame of our network. A lot of our common papers in area of joint program and joint research are published in the most famous scientific journals (CC, SCI indexed) and each one contains acknowledgment to CEEPUS.

Every year we organize CEEPUS summer school and CEEPUS workshops in order to improve our activities in the frame of CEEPUS HR 108 network. Also, in 2011/12 year the special web portal for CEEPUS CIII HR 108 is implemented and additional functionality are applied in 2018/19. In 2018/19 we are continuing with integration with google like services. Last year 2021, we have organized online summer school as a pilot project due to pandemic situation, as a part of **RI-STEM student conference. Due to reason that was largely successful it is planned in cooperation with Student association of Faculty of Engineering UNIRI**

**in 2023.** This online summer school will be followed by students from other partners in the network. Special CEEPUS winter/summer school it will be organized in recent years and in 2022/23 is planned to be held again. Special short-term excursions in accordance with CEEPUS III are planned in 2022/23.

We prepared and established our books and other teaching materials in English language and in 2022/23 we will continue with our books and other teaching materials in English language.

We prepared and established our joint programs excellent and in past years and during 2022/23 we will continue to work on it in order to be ideal. Generally, all old planned activities will be continued and new planned will be harmonized and adopted in accordance with new CEEPUS III Agreement.

However, major step is starting joint degree program. **This year as a pilot model will be introduce firstly BSc joint degree, which it will be followed MSc degree.** This pilot study initially will be introduced by following new partners in the network **Croatian Catholic University** and **Pázmány Péter Catholic University**. This activity will be supported by European Social Fund project *“Development of a joint graduate study of software engineering at the Croatian Catholic University and the Pázmány Péter Catholic University in Budapest”*.

## **Network Activities**

### **Type of instruction planned Others:**

Additional activities, not presented in the section »Type of instruction planned« support the aims of the project to develop comparable modern curriculum in the field of concurrent product and technology development.

Additional activities are:

Internships provide opportunities for gaining of experience in the field of network, determine an interest in a career and create a network of contacts,

Implementation of knowledge about modern CAE environment and advanced modelling by implementation of the HPC in undergraduate and postgraduate studies.

Aspects of modern conventional and non-conventional production technologies in education and science.

Exchange of all level of students (undergraduate and postgraduate) as well as the university teachers will enable the dissemination of the knowledge in the field of manufacturing technologies.

Scientific conferences and workshops where teachers, postgraduate students will present their work.

Scientific conferences and journals where the best diploma works will be presented to encourage students for scientific work.

Taking part in diploma examinations (MSc, PhD).

Taking part in postgraduate studies (MSc, PhD).

Improvement of language skills on all levels of the academic population (students and teaching staff).

Courses on Artificial intelligence.

Courses on measuring digitizing devices.

Courses on CNC machines.

Courses on advanced modelling by use of the high performance computing

Finishing of the MSc and PhD thesis at hosting universities.

Assistance with work on a diploma and doctoral thesis.

Participation of hosted teachers at MSc and PhD dependence as member of defendant board or co-mentor.

Participation of incoming students and teachers on lectures and lessons in host university. PhD Student Workshops.

Also, using of E-learning in network tasks and in that purpose online training course on LMS Moodle system.

### **Language of instruction planned Others**

English, German, Croatian, Czech, Polish, Slovak, Macedonian, Serbian, Bulgarian, etc.

We use Slavic root language also as third language ( English -first, German-second) but only at Slavic roots partners because the partners from Croatia, Poland, Slovenia, Slovakia and Czech Republic have the same Slavic roots.

### **Background Information**

I have experiences in previously CEEPUS program. Firstly, I was a CEEPUS student and I have made my diploma thesis by means of CEEPUS I program. Also, by means of CEEPUS program, I was having post-doc experience. thesis. Afterwards, I was a deputy of local coordinator and housing contact of Academic Network CII-RO-0013, CII-SK-0030, and CII-PL-0033. Also, I was in touch with Mr. Sovagovic for the first application from our NCO and later on with Croatian Agency for mobility I have to find out a lot of about CEEPUS. The second source of information is International Relations Office of our University. For me this is the best developed international program for mobility, research and science. In 2011 year, as Vice-dean of faculty a I promote CEEPUS program as the best program for university studies. During 2011 year Dean of the faculty have introduced institutional CEEPUS coordinator, this is for a reason to increase qualities of mobility's, and I was named at that position.

### **Objectives**

According to CEEPUS III Work Programme our developed and promoted university network is focused to stimulate academic mobility, in particular regional student mobility i.e. joint programs in the frame of CII HR 108 network leading up to double i.e joint degrees and joint thesis supervision and planned mobility actions will be set in that direction. Planned mobility actions are more stressed on joint doctoral programs

with the workload for teachers in the sense of at least six teaching or supervising hours a week at the host university in accordance with CEEPUS III Agreement.

In the year 2022/23 we have planned to continue our CEEPUS HR 108 project with next stage of objectives that are composed in the way to make synergy and intensify mobility exchange of students and teachers in the field of industrial and production engineering and manufacturing technologies with an emphasis on concurrent product and technology development joint program. Network partners are specialized in the frame of a different area of industrial, production and manufacturing engineering and connecting in the proposed network will improve and increase their educational, scientific, research and practical outcomes.

The main objectives of proposed networks in the year 2021/22 we have are focused on elaboration of our Joint program in:

- Common elaboration and implementation of PhD thesis /Thèse en cotutelle/
- Joint Master program - Concurrent Product and Technology Development
- Joint PhD program - Concurrent Product and Technology Development

Particularly the main objectives in the frame of CII HR 108 network in the year 2022/23 are:

1. Legalization and accreditation of joint program „Concurrent Product and Technology Development“ for BSc and MSc in the technical field. **We are planning pilot to start in academic year 2022/23.**
2. Legalization and accreditation of joint program „Concurrent Product and Technology Development“ for PhD study in the field of industrial and production engineering and manufacturing technologies. For this purpose we will apply projects on the Erasmus plus program and European social fund scheme dedicated for Croatia (internationalization of the PhD programs)
3. Making of common PhD thesis /Thèse en cotutelle/ in the field of industrial and production engineering and manufacturing technologies.
4. Forming a workload for teachers in the sense of at least six teaching or supervising hours a week at the host university in accordance with CEEPUS III Agreement.
5. Enhanced the exchange of students

Particularly the main objectives in the frame of CII HR 108 network in the year 2022/23 are:

1. Legalization and accreditation of joint program for BSc and MSc study in the field of engineering. For this purpose, we will apply projects on the Erasmus plus program and European social fund scheme dedicated for Croatia (internationalization of the PhD programs). **It is important to note that this year as a pilot model will be introduced firstly BSc joint degree, which it will be followed MSc degree.** This pilot study initially will be introduced by following new partners in the network **Croatian Catholic University** and **Pázmány Péter Catholic University**. This activity will be supported by European Social Fund project

***“Development of a joint graduate study of software engineering at the Croatian Catholic University and the Pázmány Péter Catholic University in Budapest”***. This model is planned to be in latter development introduced between other interested partners of the CEEPUS network.

2. Legalization and accreditation of joint program for PhD study in the field of industrial and production engineering and manufacturing technologies. For this purpose we will apply projects on the Erasmus plus program and European social fond scheme dedicated for Croatia (internationalization of the PhD programs)

3. Making of common PhD thesis /Thèse en cotutelle/ in the field of industrial and production engineering and manufacturing technologies.

4. Forming a workload for teachers in the sense of at least six teaching or supervising hours a week at the host university in accordance with CEEPUS III Agreement.

5. Enhanced the exchange of students with a special attention to undergraduates.

6. Creating of conditions for making of joint diploma that will follow the guidelines of the Bologna process regarding the developed curriculum on the Master and PhD level.

7. Finishing the rest of common CEEPUS scientific books in English language according to the joint program that will be used for master and PhD level i.e. Master and PhD. degree. All partners in our CEEPUS network CIII-HR-0108-Concurrent Product and Technology Development - Teaching, Research and Implementation of joint programs oriented in production and industrial engineering have taken a part in the CEEPUS scientific books with one more chapters in the books on the subject connected on our joint program.

8. Finishing of the common book with information about our laboratories where our students could do their Master and PhD. thesis connected on joint program. Materials for this are prepared.

9. Continuing and promoting of researches regarding different field of our partners and regarding different possibilities of our laboratories in order to obtain the best scientific results.

10. Preparing of the Science Report of HR 108 network containing the papers of our common research in the frame of our network. A lot of our common papers in area of joint program and joint research are published in the most famous scientific journals (CC, SCI indexed) and each one contain acknowledgement to CEEPUS (check on:<http://www.sciencedirect.com/>).

11. Implementation of electronic activities in area of joint program regarding electronic presentations, virtual laboratories, e-books, etc. by means e-learning through learning management system Moodle (see site with our CEEPUS network involved in e-learning on: <http://moodle.srce.hr/course/category.php?id=110>).

12. Organizing the summer school in June/July 2022 and September 2021 in Rijeka (every year we organize summer school in Rijeka), partially online due to pandemic.

13. Organizing periodical workshops at every partner university regarding the fact that network partners are specialized in the frame of different area of industrial, production and manufacturing engineering.



14. The developed curricula strongly connect with the industrial needs. Therefore, the joint program in the proposed field has to be connected to the industrial projects and the demands of enterprises of the participating countries.
15. Stimulate and develop of common research cooperation in the field of industrial and production engineering and manufacturing technologies.
16. Connecting of the research and mobility with industry in order to enhance student experience.
17. Set-up of proper conditions for student exchange represents also the determination of specific subjects and scientific topics which are most intensified by particular network partners.
18. Determine common topics and courses which can be studied on several universities as well as the courses which are supplementary among the network partners
19. Updating the knowledge containing the publications, diploma works, MSc-PhD works and scientific work elaborated at the partner departments. Also, excursions, visitations of laboratories, student and teacher mobility are the main basis for exchange knowledge and experiences. Using of e-learning in improving of network and supervising activities.
20. Preparing of conditions for including new partners from CEEPUS countries not included in our network regarding joint program.
21. Organizing and common attending of conferences where we are the main organizer, the chairman's and the members of scientific boards regarding improving of our research and educational knowledge (see site <http://www.in-tech.info/>, [www.daaam.com](http://www.daaam.com), <http://www.gepeszet.bme.hu>, etc.).
22. Publishing of results of supervised thesis with our students in different journals with acknowledgement to CEEPUS regarding common supervision (e.g. see site [http://www.riteh.hr/izda\\_djel/er/index.html](http://www.riteh.hr/izda_djel/er/index.html) , [http://hrcak.srce.hr/index.php?show=clanak&id\\_clanak\\_jezik=61889](http://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=61889), etc.).
23. Organizing the language workshops for our partners in order to improve their language skills.
24. Organizing the special short term excursion in accordance with CEEPUS III.
25. During 2017 and 2018 we have been making procedural and organizational preparations for joint diploma agreements. Also we have included Russian, Latvian and Estonian Universities as silent partners in 2013/2014, for possible future cooperation, which will give additional value to our network with possible activation. This academic year we will strength a network activities and prepare network for next year expansion to the rest of the CEEPUS countries.

Generally, all old objectives will be continued and new objectives will be harmonized and adopted in accordance with CEEPUS III Agreement, with a special attention to undergraduates.

### **Biggest Achievement and Plan**

In order to create advanced curriculum mutual scientific researchers were conducted; obtained results were used in lectures that were held at host institutions.

**Biggest achievement and milestone is finalizing and proposition of new joint curriculum, and starting accreditation of those programs. It is important to note that this year as a pilot model will be introduced firstly BSc joint degree, which it will be followed MSc degree. This pilot study initially will be introduced by following new partners in the network Croatian Catholic University and Pázmány Péter Catholic University. This activity will be supported by European Social Fund project “Development of a joint graduate study of software engineering at the Croatian Catholic University and the Pázmány Péter Catholic University in Budapest”. This model is planned to be in latter development introduced between other interested partners of the CEEPUS network.**

One of milestones was organizing the CEEPUS workshop in the frame of September 2021. It was organized CEEPUS summer school in June-July 2022, at Faculty of Engineering in Rijeka. During CEEPUS workshop and summer school **50 technical scientific papers have been presented**, also it was organized a specialized visit to industrial site that implements an innovative technology. At workshop and at summer school PhD students have had the opportunity to collaborate, present their scientific researches, and work with renewed scientist of various technological fields. Following this experience periodical workshops were conducted by visiting teachers at every partner university regarding the fact that network partners are specialized in the frame of different area of industrial, production and manufacturing engineering. Improvement in developing the curricula is strongly connected with the industrial needs, projects and demands of enterprises of the participating countries. By stimulation and development of common research with regard to industry creates common topics and courses which can be studied on several universities as well as the courses which are supplementary among the network partners. It is necessary to say that silent partners have actively involved in CEEPUS workshop. **A large number of our common papers in area of joint program and joint research are published in the highly ranked scientific journals (CC, SCI indexed) in total 25 publications**, these activities will be promoted and continued. Connection between universities was further improved by implementation of electronic activities in area of joint program regarding electronic presentations, virtual laboratories, e-books, etc. by means e-learning through learning management system Moodle (see site with our CEEPUS network involved in e-learning on: <http://moodle.srce.hr/>). Organizing and common attending of conducted program has facilitated cooperation between participants and as such improved research and educational knowledge resulting in conferences where teachers are the organizers, chairman's and members of scientific boards, where PhD students are participants, organizers and editors, where students are participants. (see site, [www.daaam.com](http://www.daaam.com), <http://www.konferencija-plin.com/>, etc.). By publishing of results of joint supervised thesis with our students in different journals obtained through CEEPUS mobility helps them achieve more advanced research and access to advanced laboratory equipment. Conducted research have special acknowledgement thanking the CEEPUS network regarding common supervision (e.g. see site <http://er.riteh.hr/index.php/ER>, [http://hrcak.srce.hr/index.php?show=clanak&id\\_clanak\\_jezik=137660](http://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=137660), etc.). This year CEEPUS workshop was organized at Rijeka. Joint cooperation has facilitated organization of special short term excursion towards faculties, industries and fairs in accordance with CEEPUS III requirements.

Network activities have produce nine EU project applications and four research projects (HORIZON 2020, Erasmus+, Intereg Danube, Cross-border cooperation; several EU project application was successful, under Intereg Danube and Erasmus+ strategic grant scheme. In this moment we have **four EU financed project between the partners: Science Center for Excellence in Data Science and Cooperative Systems; DATACROSS Project - Advanced Methods and Technology in Data Science and Co-operative Systems,**

**CEKOM Smart city, and Erasmus+ project 2021-1-HR01-KA220-HED-000031177, „Introduction of joint short-style ICT courses for better employability of students and graduates (WICT)“, and European Social Fund project “Development of a joint graduate study of software engineering at the Croatian Catholic University and the Pázmány Péter Catholic University in Budapest”.** In addition, the partners from CEEPUS supported two infrastructural projects for University of Rijeka (in total 30 mil EUR), and in plan we have to support EU infrastructural projects for other partners in network.

Rijeka, 15.01.2022.

Prof. Zlatan Car, PhD.

Coordinator of the Network CIII-HR-108