MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

SELF-EVALUATION REPORT MODULE 3

EVALUATED UNIT: Faculty of Mechanical Engineering, Czech Technical University in Prague

FORD: 2. Engineering and Technology

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

MODUL 3 SOCIAL RELEVANCE

SOCIAL RELEVANCE / SOCIAL BENEFIT OF THE EVALUATED UNIT[1]

3.1 General self-assessment of the social benefit of R&D&I in the fields of research at the evaluated unit, and of the evaluated unit as a whole

The evaluated unit gives a concise, general but informative account of the benefit of R&D&I in the fields in the 2014–2018 reporting period.

Self-evaluation:

Over the past 20 years, the Faculty of Mechanical Engineering of the Czech Technical University in Prague (FME) has in many areas built up what is nowadays called an ecosystem of university-industrial cooperation. The ecosystem requires a university R&D and teaching/learning background comprising academic knowledge, often a unique instrument and experimental base, and study programs aimed at educating students in their chosen field of specialization. In order to create an ecosystem, however, it is necessary to have the entire sequence from basic science through applied science to industrial R&D. The aim of ecosystem building is to enable industrial enterprises already active in the Czech Republic (CR) to be globally competitive. This will provide benefits for the Czech economy, will raise the standard of living and will make the CR a sought-after attractive country for R&D and for producing new high-tech products. FME is indeed becoming a catalyst for the development of the Czech economy. Ecosystems have been created for the automotive, machine tool, aerospace, energy and manufacturing industries.

HTML links to additional documentation:

https://www.fs.cvut.cz/en/science-research/science-research-at-fme/en-social-benefit-rdi/

[1] *In accordance with Section 22(1) of Act No 111/1998 on universities, amending certain acts (the Universities Act), as amended.*

APPLIED RESEARCH PROJECTS

3.2 Applied research projects [2]

The evaluated unit presents a maximum of the five most significant (from the perspective of evaluated unit) applied research projects in the 2014–2018 reporting period from the complete list in the appendix (tables 3.2.1 and 3.2.2), particularly with regard to the results achieved or a project's potential for application.

Self-evaluation:

Josef Bozek Competence Center for Automotive Industry
This is a National Competence Center of TACR, dealing with vehicles from drives to driving and assistance systems with all major carriers.

Center of Competence - Manufacturing Technology
This is a National Competence Center for engineering production technology.

Center of Competence - Advanced Technologies for Heat and Electricity Production
This is a National Center of Competence for Heating and Energy as an Important Element of the Czech Economy.

Flexible Fossil Power Plants for the Future Energy Market through new and advanced Turbine Technologies
In this EU project, a methodology for predicting the thermo-mechanical fatigue of steam and combustion turbine rotors has been developed for fast start-ups to cover the power outages of alternative sources.

Research center for low-carbon energy technologies
This project is focused on research in the field of CO2 capture from combustion processes using biomass and the utilization of captured CO2. It is relevant to climate change research.

HTML links to additional documentation:

https://www.fs.cvut.cz/en/science-research/applied-research-projects/en-centres-of-competence/

[2] *Under Section 2(1)(b) of Act No 130/2002, applied research is theoretical and experimental work aimed at gaining new knowledge and skills for the developing of new or substantially improved products, processes or services; applied research includes industrial research or experimental development, or a combination of both. Under Article 2 of Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty, industrial research means planned research or critical investigation aimed at the acquisition of new knowledge and skills for developing new products, processes or services, or for bringing about a significant improvement in existing products, processes or services. It comprises the creation of component parts of complex systems, and may include the construction of prototypes in a laboratory environment or in an environment with simulated interfaces to existing systems as well as of pilot lines, when necessary for the industrial research and notably for generic technology validation; experimental development means acquiring, combining, shaping and using existing scientific, technological, business and other relevant knowledge and skills with the aim of developing new or improved products, processes or services. This may also include, for example, activities aiming at the conceptual definition, planning and documentation of new products, processes or services.*

3.3 Contract research [3]

The evaluated unit briefly comments on revenues from contract research for the 2014–2018 reporting period from the complete list in the appendix (tables 3.3.1 and 3.3.2).

Self-evaluation:

FME regularly provides contract research for industrial companies. We thus sell the innovation potential of FME to industry. This is another path, alongside ecosystems, ensuring that knowledge, procedures, instruments and analysis needed by industry will be available not only for collaborative research but also for contractual research. Both forms of research have advantages and disadvantages for industry and for FME in response to many legal, IPR, EC community framework, financial, tax and other considerations.

3.4 Revenues from non-public sources (besides grants or contract research) from research work

The evaluated unit briefly comments on revenues for the 2014–2018 reporting period for R&D&I from non-public sources, besides grants or contract research (e.g. licences sold, spin-off revenues, gifts, etc.). It presents a complete list in the appendix (table 3.4.1).

Self-evaluation:

FME systematically obtains revenues from non-public sources to fund activities that are not eligible from other sources, e.g. co-financing of R&D projects, and promotions.

HTML links to additional documentation:

https://www.fs.cvut.cz/en/science-research/science-research-at-fme/en-revenues-non-public/

[3] *For a definition of contract research for the purposes of evaluation in the universities sector, see Article 2.2.1 of the Community framework for State aid for research and development and innovation (2014/C 198/01).*

APPLIED RESEARCH RESULTS

3.5 Applied research results with an existing or prospective economic impact on society

The evaluated unit briefly comments on a maximum of the five most significant (from the perspective of the evaluated unit) applied research results that have already been applied in practice, or that will realistically be applied, in the 2014–2018 reporting period from the overview in the appendix (table 3.5.1).

Self-evaluation:

Supporting structure for repositionable and reconfigurable manipulating arms
This patent addresses the productivity of car body production lines. It is used by Compotech Plus Ltd, which cooperates with Bilsing Automation Ltd to develop robots for fast loading of sheet metal into presses.

Contract for utilization of results – a project under the title Research of Pressing Tools Service Life Extension for Refractory Highly Abrasive Materials
R&D aimed at increasing the durability of tool materials for pressing highly-abrasive refractory materials. It led to significant scrap reduction in production up to 0.1%. Thanks to this project, P-D Refractories CZ Inc. won the largest worldwide orders in the refractory market, for the supply of coke batteries for Japanese company Nippon Steel.

Ultralight aircraft UL-39 Albi (prototype) – an innovative ultralight all-composite aircraft with blower propulsion and a parachute safety system, unique in the world of sport and tourist aviation.

Prototype of a non-wood biomass boiler
This prototype of a 150 kW plant biomass boiler, which was being certified before serial production, is the first of its kind in the CR. In the past, wood biomass boilers had been certified and plant biomass boilers were imported.

Spray Dryer (demonstrator)
This new design of a spray dryer utilizes the results from current R&D investigations that produce an organic nano-structured powder with applications in the food industry and in the pharmacy industry. The license agreement is with DBH Technologies Ltd.

HTML links to additional documentation:

https://www.fs.cvut.cz/en/science-research/applied-research-projects/en-applied-research-results/

3.6 Significant applied research results with an impact other than an economic one on society

The evaluated unit gives a concise account of a maximum of the five most significant (from the perspective of the evaluated unit) applied research results with an impact other than an economic one on society in the 2014–2018 reporting period (typically results from disciplines in the humanities and social sciences) from the overview in the appendix (table 3.6.1).

Self-evaluation:

Projects undertaken in the Faculty have dealt with reducing and remedying impacts on the environment, and providing a better living environment for humans. There were projects dealing with the emissions produced by transport and their impact on human health; climate change associated with changes in temperature depending on the proportion of built-up areas and greenery; the energy use of reclaimed land after brown coal mining; adjustments to the internal environment to protect cultural monuments; and the impact on children's health of ventilation in schools, and legislation on school ventilation.

HTML links to additional documentation:

https://www.fs.cvut.cz/en/science-research/applied-research-projects/en-results-other-than-economic/

COOPERATION WITH THE NON-ACADEMIC ENVIRONMENT AND TECHNOLOGY TRANSFER

3.7 The evaluated unit's most significant interactions with the non-academic application/corporate sphere

The evaluated unit gives a concise account of the most typical users of its outputs. It explains whether and how it identifies them and how it works with them. It provides examples of a maximum of ten of the most significant interactions with the non-academic environment in the 2014–2018 reporting period.

Self-evaluation:

Typical users are manufacturers of particular machines and equipment and their users throughout the industry using collaborative and contractual research. The cooperation is created by a proactive search for R&D opportunities by FME among industry leaders, who return to FME with follow-up projects after positive experience.

Examples:

GE Aviation – has a collaborative contract with FME, and uses a comprehensive testing infrastructure of ground (dynamometric, core, propeller) and flying test cells for the new generation of turboprop engines.

ŠKODA Auto – cooperation in thermodynamic engine simulations, modeling the cycles of vehicles of all drives, gearboxes, internal and external aerodynamics, development of production technologies, etc.

Doosan Group – numerical modeling of the flow in turbines and in parts of turbines, a study on a new CO2 power cycle for WHR application

Unipetrol – R&D of machines and apparatuses in new and existing petrochemical and refinery production and new technologies for raw materials recovery

Carl Zeiss – development of automated quality inspection systems for the automotive, aerospace, transportation, medical and energy industries. The collaboration includes inspection plans, CMM programming, R&D of task-specific fixtures and verification of the whole measurement process for serial production.

Gamma Technologies (USA) – collaboration in research/commercial development/use of GT-Suite software, with a global leader in the field of simulation of internal combustion engines and drive chains.

Tajmac-ZPS – R&D of new concepts of machine tools, e.g. a patented principle for multi-spindle lathes with 75% increased productivity, and cable-based mechatronic stiffness for portal machine tools.

Compo Tech PLUS – co-realization of composite structures with high-performance stiffness and strength parameters, e.g. construction of a light frame for a composite bicycle

ProSpon – R&D of all large joint replacements in cooperation with clinical practice, cooperation in the introduction of implants, tests on 3D printing materials from biocompatible titanium alloys

Brano – regular innovative brainstorming to find new areas of cooperation with FME. A typical result is a worldwide patent protection solution, e.g. the front cover of a car, a damper with a degressive characteristic.

HTML links to additional documentation:

https://www.fs.cvut.cz/en/science-research/applied-research-projects/en-results-non-academic/

3.8 System and support of technology transfer and intellectual property protection (can be extended to the whole university, emphasising the specific features of the evaluated unit)

The evaluated unit gives a concise account of its system of technology transfer. It conducts an evaluation of the quality of its applied research and the effectiveness of technology transfer using the data presented in the appendix (table 3.5.1). This commentary will highlight the number of filed and granted patents (Czech and international) and licences sold.

Self-evaluation:

The Technology Transfer and Intellectual Property protection system of CTU has a centralized base within the University rectorate. In addition, FME has internal regulations for IPR, conflict of interest and protection of confidential information. FME has model license agreements for master theses with companies and for companies outside FME.

HTML links to additional documentation:

http://evaluation-cvut.cz/files/H2020-Technologytransfer.pdf

3.9 Strategy for setting up and support of spin-off firms or other forms of commercialization of R&D&I results (can be extended to the whole university, emphasising the specific features of the evaluated unit)

The evaluated unit gives a concise account of the practical use of its intellectual property in the form of setting up spin-off firms or other forms of commercialising R&D&I results (both with or without the participation of the university) established by the evaluated unit (university), another entity controlled by the evaluated unit (university), or an employee of the evaluated unit, presenting the model for their functioning and coordination, and control of intellectual property management of the evaluated unit (university).

Self-evaluation:

CTU has a Technology Transfer Office, the InQBay incubator, and a strategy for commercialization of IP. As an extension, FME regularly concludes license agreements on the use of results for collaborative projects. FME offers licensing agreements to companies owned by faculty staff.

HTML links to additional documentation:

http://evaluation-cvut.cz/files/H2020-Technologytransfer.pdf

RECOGNITION BY THE SCIENTIFIC COMMUNITY

3.10 The most significant individual awards for R&D&I

The evaluated unit presents a maximum of ten examples of the most significant R&D&I awards received (in the Czech Republic and in other countries) in the 2014–2018 reporting period.

Self-evaluation:

An award of the Technology Agency of the CR in the Partnership category – for the Josef Božek Automotive Industry Competence Center project.

Best Cooperation of Year 2016 Special prize of the Ministry of Industry and Trade of the CR – for the Advanced control and optimization of heat pump operation project (cooperation betweem FME and Honeywell, Ltd.)

Czech Innovation Award 2015 – a motion thread mechanism, awarded for the best collaboration between a research organization and an industrial enterprise.

Prize of the Chairman of the Grant Agency of the CR for 2016 - for work carried out on a grant-funded project on Biomechanical modeling of human voice creation – a way to artificial vocal cords.

Gold Medal of the 58th International Engineering Fair in Brno 2016 in the category of Innovations in Transport and Logistics, for the prototype of the UL-39 Albi ultralight aircraft.

Gold Medal of the 59th International Engineering Fair in Brno 2017, for the prototype of WeldPrint MCV 5X.

International Award for Lifetime Achievement in Turbomachine Research Prof. Pavel Šafařík.

European Federation of Chemical Engineering Personal Recognition Award in Mixing Prof. Pavel Ditl.

Edwin Walker Prize 2014 from the Institution of Mechanical Engineers (Power Industries Division) London, UK for an article: Petr, V., Kolovratník, M.: Wet steam energy loss and related Baumann rule in low pressure steam turbine. Journal of Power and Energy. 2014, 228 (2), 206-215.

1st place for a presentation on Nanomechanical Characterization of Titanium Alloy Modified by Nitrogen Ion Implantation, at the 18th Int. Conf. on Advanced Materials and Nanotechnology 2016

HTML links to additional documentation:

https://www.fs.cvut.cz/en/science-research/en-awards-rdi/

3.11 Recognition by the international R&D&I community

The evaluated unit provides the following information / examples demonstrating recognition by the international scientific community in the 2014–2018 reporting period, with a commentary:
It presents a maximum of ten examples of its academic staff's participation on the editorial boards of international scientific journals (e.g. editor, member of the editorial board) in the appendix (table 3.11.1),
It presents a maximum of ten examples of the most significant invited lectures by the evaluated unit's academic staff abroad in the appendix (table 3.11.2),
It presents a maximum of ten examples of the most significant lectures by foreign scientists and other guests relevant to the R&D&I field in the appendix (table 3.11.3),
It presents a maximum of ten examples of the most significant elected memberships of professional societies (table 3.11.4).

Self-evaluation:

FME employees are active members of editorial boards and editors of more than 20 national and international scientific and professional journals relevant to fields covered by FME. They review articles published in journals by Elsevier, Springer, Taylor&Francis and by International Scientific Societies. They are involved in the scientific committees of conferences. They give invited lectures and invite important foreign experts to FME for conferences and visits. They are elected members of more than 20 national societies and 15 international societies.

POPULARISATION OF R&D&I

3.12 The most significant activities in the popularisation of R&D&I and communication with the public

The evaluated unit gives a concise account of its main activities in the area of popularisation of R&D&I and communication with the public in the 2014–2018 reporting period, and presents a maximum of ten examples that it considers the most significant.

Self-evaluation:

The activities involve publishing results in traditional and specialized media and on social networks, presentations at trade fairs and for lab tours:

- Promoting articles and interviews. Approx. 1,000 over the period.
- 2 press conferences, 8 press releases, an average of 48 articles per year for the media.
- Presentations at trade fairs: Int Eng Fair in Brno, Future Forces, AERO Friedrichshafen, etc.
- Presentations at events for the public 5 times a year, and presentations of FME labs 8 times a year.

HTML links to additional documentation:

https://www.fs.cvut.cz/en/science-research/science-research-at-fme/en-popularisation-rdi/

APPENDICES (TABLES)

3.2 Applied research projects

3.2.1 Projects supported by a provider from the Czech Republic

As the beneficiary						
Provider	Project title	Support (EUR thousand)				
		2014	2015	2016	2017	2018
Min Ind Trade CR	Ducted Fan Ultralight Aircraft	392,26	137,52			
Min Ind Trade CR	Selection of the Outdoor Air Parameters for Designing of Heat Exchangers in Air-Conditioning		27,97			
Min Edu Youth Sports CR	Development of Vehicle Centre of Sustainable Mobility	323,43	529,08	462,55	452,53	450,84
Min Edu Youth Sports CR	Support of Sustainability of the Innovation Centre of Diagnostics and Applications of Materials at CTU-FME in Prague	85,90	84,05	9	89,21	88,06
Min Edu Youth Sports CR	Sustainable Hydrothermal Manufacturing of Nanomaterials	30,65	5,90	2,81		
Min Edu Youth Sports CR	Damage risk assessment, economic impact and mitigation strategies for sustainable preservation of cultural heritage in the times of climate change.	10,50				
Min Int CR	Protection of persons against explosion					97,84
TA CR	Fatigue Analysis Documentation Office	172,41				
TA CR	Development and application of measurement devices for water plants of small and medium power	15,47	78,25	81,94	62,48	
TA CR	Research and development of advanced boiler for herbaceous biomass	53,35	107,39	109,87	105,70	
TA CR	Protection of zirconium alloys surfaces by polycrystalline diamond films.	49,10	101,20	52,68		

TA CR	Increasing the efficiency of the ducted fan for small aircraft	55,39	152,11	136,61	21,76	
TA CR	Tribological coatings with improved corrosion protection for orthopedic and trauma applications	92,98	200,82	217,22	177,59	
TA CR	Injection moulding technology of bioceramic materials for implant components	159,84	203,57	214,70		
TA CR	Research of oxyfuel combustion in a bubbling fluidized bed for CCS technologies	141,07	106,59	91,78		
TA CR	Research in Intelligent Methods for Economical-Environmental Control of 100 kW Residual Biomass Boiler Prototype	34,50				
TA CR	Mixing Equipment for Sludge Processing	22,88				
TA CR	New materials and coatings for joint replacement bionical design	402,79				
TA CR	Fatigue Analysis Documentation Office	172,41				
TA CR	Advanced technologies for heat and electricity production	774,05	846,57	837,42	694,83	795,77
TA CR	Josef Bozek Competence Centre for Automotive Industry	1601,21	1695,78	1580,99	1566,35	
TA CR	Competence Center - Manufacturing Technology	1065,99	1127,08	982,50	1006,46	1035,76
TA CR	Additive manufacture of high value joint replacement - reliability, performance, individuality			85,82	174,74	218,89
TA CR	Developing tool for prediction and verification of safety and endurance of small arms during impact tests				17,74	24,96
TA CR	Optimization and testing of unmanned aerial vehicles of new concepts				108,43	147,88
TA CR	Precise initialization of water turbine blade geometry using panel				55,64	62,08

	methods and vortex wake					
TA CR	Innovative in-line CNC woodworking centers, including automatic multifunctional cell.				119,45	123,04
TA CR	NOx reduction by SNCR for bubbling fluidized bed boilers				11,93	59,74
TA CR	Development of a unit for recovering waste heat from extrusion and pressing of oilseeds				16,79	48,59
TA CR	Study of influence of surface treatment of polymers and metals on strength of polymer-metal joints with potential use in composite systems					50,58
TA CR	Research and development of advanced boiler for non-wooden biomass II					10,30
TA CR	Local sources of heat and electricity in the municipal environment with possibility of island mode operation					52,26
TA CR	Managing migration with a special focus on Ukraine as a tool for reducing the workforce deficit and increasing the competitiveness of Czech industry					66,26
Total		5656,19	5403,88	4946,88	46981,62	3332,84
As another participant						
Provider	Project title	Support (EUR thousand)				
		2014	2015	2016	2017	2018
Min Ind Trade CR	Research of the Influence of Orbital Head Welding Technology of Thick-Walled Tubes/Pipes on Their Long-Term Lifetime in Conditions of Modern Power Plants Service	37,77	26,39			
Min Ind Trade CR	The Increasing of the Load Capacity for the Gearing of the Spur and Helical Gears with help of the Optimization of the Heat, Chemical-heat	33,60				

	and Mechanical Treatment					
Min Ind Trade CR	Research and development of the new generation of the rotary table RT6300-C	29,06				
Min Ind Trade CR	Research of methods of severe accident analysis and risk analysis with the aim to propose conception of further increasing of safety of Czech NPPs operation after Fukushima events	10,90				
Min Ind Trade CR	Large horizontal machine HCW4000-CX	58,11				
Min Ind Trade CR	Heavy-duty vertical lathe table 40/47 with modular drive	53,75	47,28			
Min Ind Trade CR	Complex Solution of Machine Tool Thermal Deformation	78,71				
Min Ind Trade CR	Milling ram for exchangeable milling heads with drilling spindle	55,21				
Min Ind Trade CR	Inprocess measurement	85,35				
Min Ind Trade CR	Development o the hi-tech composite sandwiches for ballistic protection	36,43				
Min Ind Trade CR	Research and deveopment of a bus skeleton from unconventional materials	49,47	15,39			
Min Ind Trade CR	Flexibile machine tool	52,23				
Min Ind Trade CR	Methodology of the Process Analysis for Production of Alloyed Steel Castings with Higher Utility Properties for Heavy and Power Industry	39,44				
Min Ind Trade CR	Conchoidal hydrogenerator - high pressure hydraulic pump of new kinematical conception with rolling piston	43,58				

Min Ind Trade CR	Safety of New Generation of Nuclear Power Plants	130,75				
Min Ind Trade CR	Advanced Leveling and Stabilization System for Active Floating Mobile Modular System (APMMS) for the transport of large structures.					47,73
Min Ind Trade CR	Development of a new generation of nails for osteosynthesis of long bones of the lower limb					28,47
Min Ind Trade CR	Development of new homogenization technology high viscous dispersion of the non-newton type					45,16
Min Ind Trade CR	Design and manufacturing process development of primary aircraft parts of advanced shapes of reinforced thermoplastics					21,45
Min Ind Trade CR	Energy efficient cover for advanced production machines					44,38
Min Ind Trade CR	Smart machine tool					88,52
Min Ind Trade CR	Heavy Duty Grinder TOS Hostivař					95,93
Min Ind Trade CR	Development of a sampler for grain sampling					46,80
Min Ind Trade CR	Automatic Field Infiltration Measuring Two-Ring Device					32,95
Min Ind Trade CR	Vertical milling center of medium size with increased precision					77,21
Min Ind Trade CR	Research and development of a higher efficiency electric traction system for an electric bus					53,82
Min Ind Trade CR	Laser technologies for microstructuring of bionic and functional surfaces of advanced materials					26,13

Min Ind Trade CR	Development of technological accessories for machine tools				53,17	81,89
Min Ind Trade CR	The modular system of knee joint replacement to enable reconstruction of large defects using porous augmentation and individual replacement for the extreme deformity of bone tissue.				30,38	62,40
Min Ind Trade CR	Research and development of high-speed, high-pressure pumps				19,56	54,21
Min Ind Trade CR	Laser technology designed for additive nad hybrid metals manufacturing				46,71	92,03
Min Ind Trade CR	Additive nad hybrid manufacturing technology without the use of laser				91,91	147,41
Min Ind Trade CR	Development of design and production technology of molds for refractory vibrocasted materials			12,95	53,55	55,38
Min Ind Trade CR	Development of technology for production of ceramic chimney pipes to improve their utility properties and reduce production costs.			15,91	65,70	71,36
Min Ind Trade CR	Biofilter with dielectric heating			8,21	45,16	44,30
Min Ind Trade CR	The Development of the Impeller for Turbomachine Wheel with the Cover Discs for a Turbomachine			43,21	79,49	77,60
Min Ind Trade CR	Termovision system for non-destructive testing of weld joints			15,02	25,33	26,60
Min Ind Trade CR	Energy Efficiency Maximization of KOVOSVIT MAS Machines			37,36	153,06	134,54
Min Ind Trade CR	Virtual machining as a support of advanced manufacturing technologies for			53,64	97,23	101,78

	productive and precise machining of complex-shaped parts					
Min Ind Trade CR	Hybrid manufacturing of cutting tools made of ultra-hard materials			36,25	104,82	88,72
Min Ind Trade CR	Development of a new interpolator of the Czech CNC system for production machines			33,29	77,29	82,87
Min Ind Trade CR	Performance and technology optimization of multiaxes machine tools			56,60	121,53	112,70
Min Ind Trade CR	Development of new cleaning technology, sterilization and surface functionalization of materials			6,07	13,67	18,33
Min Ind Trade CR	The research of increase shape accuracy wax pattern of castings stracionary turbochargers and gas turbines.			23,30	47,85	46,80
Min Ind Trade CR	Innovation of an unconventional ultralight all-composite airplane			25,89	75,96	93,59
Min Ind Trade CR	Development of processes applicable to development and production of components for the space industry			9,80	46,71	47,97
Min Ind Trade CR	Exhaust of Contaminants in Industrial Plants					3,90
Min Int CR	Research and development of the device for efficient searching and securing of dactyloscopic traces				16,82	18,60
Min Int CR	Safety improvement of extension ladders for firefighters			22,79	23,89	24,41
Min Health CR	Unexpected complications of fixed orthodontic retainers	16,42	12,17			
Min Health CR	Analysis of visceral pelvic fascia defects in women	16,05	13,23			
Min Health CR	the optimalization of physical characteristics of vascular substitutes for low flow	23,83	24,04			

Min Health CR	Development and comprehensive evaluation of novel injectable, resorbable, porous bone substitute with controlled release of antimicrobial agents					16,18
Min Health CR	Comprehensive pre-clinical evaluation of lateral lumbar spine fusion with hybrid biodegradable nanocomposite porous implant.				28,33	36,77
Min Health CR	Development of innovative biotribological medium for boundary lubrication restoration.		20,01	3	31,60	33,77
Min Health CR	The study of new materials used as articulation surface of joint replacement		10,63	16,54	17,77	19,26
Min Health CR	Technologies of nano-tubes and nano-silver for antibacterial surface treatment of orthopaedic implants		17,89	24,71	23,47	24,10
Min Health CR	The use of nonatigen fish collagen in construction of implants and as drug carriers.		30,31	46,76	47,70	49,14
TA CR	System for monitoring of structures using fiber optic sensors	17,14	39,11	43,39	20,58	
TA CR	Air Cooled Condensers for Power Engineering	38,68	147,16	151,48	132,47	
TA CR	Multifunctional ram with high stroke of a box-in-box concept	17,43		47,50	94,57	44,46
TA CR	Development of technology providing absolute vertical boreholes for security monitoring system of dams	21,61	34,09	33,66		
TA CR	Research and development of technologies for obtaining vegetable oils and cakes with an emphasis on quality of cakes as feed and the appropriateness of used	20,59	46,84	47,20	47,89	

	of the construction materials.					
TA CR	Integrated Tanker Superstructure for Fire Vehicles made by Hybrid Technology	10,46	25,66	22,93		
TA CR	Non-invasive experimental techniques for research of pumps	30,51	64,07	60,30	29,62	
TA CR	The selection and implementation of procedures for low-cycle fatigue evaluating of reactor pressure vessel internals including multiaxial stress state	12,71	25,66	25,89	26,59	
TA CR	Research and development of new generation of application cylinders for flexographic printing and laminating technology using composite, nanocomposite and hybrid materials.	15,73	31,89	32,40	16,26	
TA CR	Advanced technology development of high power grinding for dynamically loaded parts from hard-to-machine super-alloys for power and aeronautics industry with respect to surface integrity	31,24	60,84	61,59	36,27	
TA CR	Research and development of mobile tricanter design and manufacturing technology	22,16	49,66	50,31		
TA CR	QUADRATIC – a new progressive production technology in the field of thin-walled welded tubes production	11,44	22,65	22,86	22,94	
TA CR	Development of resorbable collagen-calcium phosphate nanolayer with controlled elution of antibiotics for implants survival rate enhancement	14,31	36,51	43,91	45,61	
TA CR	The development of intelligent	10,21	29,10	41,69	46,30	

	endoprosthesis with automatic early detection of potential failure.					
TA CR	Heat pumps advanced control and process optimization	36,32	36,65			
TA CR	Addressing hip cup replacement of severe acetabulum defect	25,50	53,29	54,05		
TA CR	Development of surface treatment technologies with low degree of hydrogen ingress	40,79	40,72			
TA CR	Research and development of modern technology processes for new application of high-tech reinforced thermoplastic	33,81	33,61	23,16		
TA CR	Research of an advance control method of the solid fuels combustion	29,06	23,82			
TA CR	Technology and System for Physical and Spatial Characteristics Determination for Protection and Formation of Environment and for Increasing of Energy Sources Potential	51,17				
TA CR	Development of two stage charging group for big reciprocating engines	99,92	102,66	10,17		
TA CR	Aerodynamics of Highly Loaded Blade Cascades	90,80	91,63	92,48		
TA CR	Materials research of the properties and behaviour of thick-walled clad pipe bends for economically important applications, including managing the production certified by notified body with European powers.	35,38	38,52	33,88		
TA CR	Acceleration Simulator of Vehicle Crashes	21,79	16,05	1,18		
TA CR	New generation of construction kits for technical education.	35,99	36,32			
TA CR	Actuator of back leed	53,39				
TA CR	Research and development of new	88,55	93,68			

	hybrid composite structures with damping.					
TA CR	Integration, Modularity and Reconfigurability of the TOS NOVA Consortium Machines	117,46	118,54			
TA CR	Compensation of machine tool dynamic	51,43				
TA CR	Productive machining of precise workpieces	106,85	107,83			
TA CR	Research of pressing tools service life extension for refractory highly abrasive materials	44,67				
TA CR	Optimalization of pressure sewerage systems by means of mathematical modeling of their operating status.	30,84				
TA CR	Progressive Material-Technological Increase in Efficiency of the Turbine Blades Production	53,03				
TA CR	Optimization of enameled mixing equipment according to technological needs of end users	23,24				
TA CR	Surface integrity research after impementing new progessive techniques of machining using 4 and 5 axis milling machining centers.	54,48				
TA CR	Development of new composite paint coatings based on 1D nanoobjects	31,05				
TA CR	Springing of rotary working organs	13,62				
TA CR	Reasearch and Development of a Light Superstructure for Electrobus	40,06				
TA CR	Výzkum možnosti využití fyzikálních a matematických modelů pro řešení problematiky prašnosti v reálných podmínkách komplikovaného terénu.	13,08				
TA CR	Large aperture composite structures for	9,70				

	high-power laser active and adaptive optics					
TA CR	Advanced design of the total disc replacement using modern engineering methods and progressive technologies	53,14				
TA CR	The development and modernization of blade attachments of steam turbines for theirs reliability and lifetime increase.	40,82				
TA CR	Cooling Towers Plume Abatement	95,52				
TA CR	Advanced Aerostructures Research Centre		129,13	120,74	173,30	130,91
TA CR	Research center of surface treatment	124,29	134,92	142,01	153,29	148,54
TA CR	Centre for Applied Cybernetics 3	1 057,49	1 041,27	1 130,80	1 159,44	1 226,77
TA CR	Competence Center of Railway Vehicles	72,64	73,31	73,98	75,96	77,99
TA CR	Research and development of the electroformed biomimetic materials with gradient and composite composition for biomedical applications and smart manufacturing					25,39
TA CR	High-speed and lightweight reducer of Electric Vehicle using composite materials				133,54	132,43
TA CR	Development of effective pilot training tools and methodology with emphases for increasing the flying safety			44,39		
TA CR	Epicyclic Continuously Variable Transmission					29,25
TA CR	Gyroscopic Simulator of Vehicle Crashes					27,30
TA CR	POLYBET - Development of technological line for waste thermoplastic and recycled construction waste recovery for production of polymer concrete building components				33,16	34,59

TA CR	The development of new generation of devices for long-bone osteosynthesis					47,46
TA CR	Gradient functionally structured hip implant with a long life span					35,33
TA CR	Truboprop engine performance improvement via development of advanced finishing technologies					58,96
TA CR	Landfills leachate water reduction					50,31
TA CR	Novel ways to dry extruded feeds					48,40
TA CR	Development & Validation of Control Algoritms of High Speed Electric Machines					32,76
TA CR	Progressive nanotechnologies for food and medical applications.		14,48	15,06	15,00	
TA CR	Advanced system for vehicle rear view monitoring with protection against damage and dirt				57,27	57,40
TA CR	Acustic optimization of induced draft cooling towers				75,28	72,50
TA CR	Innovation of key structural nodes of water turbine				54,69	64,74
TA CR	Intelligent diagnostic unit of street lighting poles				28,48	29,25
TA CR	UL-LSA STOL class aircraft „KITPLANE“ – developmnt, prototyping and testing of novel aircraft				37,37	59,04
TA CR	Turbine profile cascades for supersonic flow fields				28,33	29,09
TA CR	Modeling of CHF-boiling crisis by using CFD computer codes				36,88	38,18
TA CR	Advanced Analytical Tools for Severe Accident Simulations				18,99	19,50

TA CR	High performance polymer implants with bioactive surface				56,13	66,88
TA CR	Development of new technology for common application of electrophoretic paint systems				37,03	34,16
TA CR	Research of NOx reduction in flue gas within the oxyfuel combustion CCS technology				61,91	61,46
TA CR	Headstock HS180 for horizontal boring machines				61,98	71,13
TA CR	Increase of multi-functional turning machining centre accuracy				71,78	77,68
TA CR	Robotic machine head				86,59	101,55
TA CR	Implementation of multi-physics numerical analysis into the development process opto-mechanical systems				65,82	74,84
TA CR	Development of a new series of planetary gearboxes, with flexible pin technology, for industrial and energy applications, in order to minimize overall dimensions, weight and internal transmission losses.		52,56	54,01	50,51	
TA CR	The development of accurate rifle with a composite hybrid barrel		59,60	59,48	55,91	
TA CR	Treatment of concentrated waste suspensions from energetic equipment		16,16	17,87	10,37	
TA CR	Research and development of the unified series of large-capacity electric buses.		48,57	60,33	64,19	
TA CR	Progressive nanotechnologies for food and medical applications.		14,48	15,06	15,00	
TA CR	Life extension and repair process development of Ti6Al4V compressor		64,14	64,74	57,05	10,06

	blades used in turboprop engines					
TA CR	Reduction of Hg, HCl and HF concentrations from large industrial sources					18,52
TA CR	Efficiency Increasing of Turbine Wet Steam Last Stages					68,24
TA CR	Conceptual design of safety-important components of helium-cooled fast demonstration reactor ALLEGRO					18,21
TA CR	Conditions and resources for the sustainable development of the quality of working life in the Czech Republic in the era of the emerging industrial revolution					13,02
Total		3800,75	3272,55	3216,81	4733,04	5411,46

3.2.2 Projects supported by a provider from another country

As the beneficiary						
Provider	Project title	Support (EUR thousand)				
		2014	2015	2016	2017	2018
EC	INTElligent FIXture for the manufacturing of low rigidity components	49,40	29,87	3,59		
EC	Integration and Management of Performance and Road Efficiency of Electric Vehicle Electronics	33,34	56,45	6,95		
EC	New materials and control for a next generation of compact combined solar and heat pump systems with boosted energetic and exergetic performance	22,34	4,98			
EC	Dynamic manufacturing of thin-walled work pieces by Milling process	82,01	8,36			
EC	Sustainable Hydrothermal Manufacturing of Nanomaterials	30,65	5,90	2,81		
EC	Damage risk assessment, economic impact and mitigation strategies for sustainable preservation of cultural heritage in the times of climate change.	10,50				

EC	Centre for civil nuclear cooperation	39,95	40,32			
EC	Development of advanced engine brake for diesel trucks engines				78,16	
EC	Large-volume transport and temporary storage of mixed municipal waste					143,47
EC	Research centre for low-carbon energy technologies					1 836,76
EC	Center of Advanced Aerospace Technology					26700,39
Total		268,19	145,88	13,35	78,16	28680,62
As another participant						
Provider	Project title	Support (EUR thousand)				
		2014	2015	2016	2017	2018
EC	TURBOmachinery REtrofits enabling FLEXible back-up capacity for the transition of the European energy system				87,61	
EC	ADvancing user acceptance of general purpose hybridized Vehicles by Improved Cost and Efficiency				110,60	
EC	Future Research, Advanced Development and Implementation Activities for Road Transport				13,02	
EC	IMplementation of Powertrain Control for Economic and Clean Real driving emIssion and fuel ConsUMption			15,66		14,00
EC	Flexible Fossil Power Plants for the Future Energy Market through new and advanced Turbine Technologies			106,62	43,34	
EC	Real World Advanced Technologies for Diesel Engines			28,66	26,01	
EC	Gas-Only internal combustion engines		41,57		63,55	59,93
EC	The innovative system for coke oven wastewater treatment and water recovery with the use of clean technologies			49,67		
EC	Clothes Perception and Manipulation	61,42				

EC	Development optalmo endoscope					6,01
EC	Research and development of diesel aircraft engines				37,79	175,10
Total		61,42	41,57	200,60	381,92	255,03

3.3 Contract research

3.3.1 Research work contracted by a client from the Czech Republic

Client	Research title	Revenues (EUR thousand)				
		2014	2015	2016	2017	2018
VUAB Pharma, a.s.	Development of a calculation methodology for thermal radiation	2,54	1,65			
Atlas Copco s.r.o.	Proof of the static strength of four types of blowers (T65 / 50, T26 / 50, T5 / 50 and DI 1 O ANT) and three coolers (D065 / 50, D026 / 50 and DO 5150) for nuclear power plants, with respect to standard PNAE G-7-002-86.	5,45	23,09			
Variel, a.s.	Numerical analysis of the static strength of tram sandwich roofs with glued equipment fixtures				11,14	
ČZ a.s.	Development of fatigue analysis pocedures for turbocharger parts.	21,88	22,05	2,54		
Honeywell, spol. s r.o.	Research and development of high performance tasks with the use of optical fiber damage detection	14,07				
Variel, a.s.	Design of a calculation model and FEM calculation of thecomposite sandwich roof of tram A		9,37			
Compo Tech PLUS, spol. s r.o.	Provision of services for testing and analysing composite materials				12,08	25,45
Meopta-optika s.r.o.	Mechanical methods and simmulations of electromechanical composite systems		10,19			
Meopta-optika s.r.o.	Mechanical methods and simulations of electromechanical composite systems				24,14	29,38

Všeobecná fakultní nemocnice	Mechanical characterization of hemostatic collagen foams					7,73
MOSA Solution s.r.o.	Determining the position of acoustic exciters for cleaning power equipment			3,70	1,86	
Vojta s.r.o.	Development of algorithms for food line control	4,62	4,96	1,30	4,82	
Dopravní podnik hlavního města Prahy	Research and measurements of the electrical properties of tram wheels				6,65	
Energocentrum Plus s.r.o.	Energocentrum Plus - Building data monitoring		9,90			
ZK-TERMOCHEM, spol. s r.o.	Monitoring manual welding and tracking evaluation for ZK-TERMOCHEM		14,62			
VM ENGINEERING s.r.o.	Intelligent Thermostat, for VM ENGINEERING		4,31			
KPC Group, s.r.o.	Prague innovation voucher	9,66				
ROX spol. s r.o.	Automated workplace for supervisory control of the output of a circular vibratory conveyor				6,08	
Teco a.s.	Relay Identification for PLC Teco Foxtrot				5,70	
Dopravní podnik hlavního města Prahy	Analysis of the system for detecting and signaling an impending collision with another tram car in the rail network					15,60
Electrolux, s.r.o. Praha	Development of an Experimental Setup					10,80
ŠKODA AUTO a.s.	Experimental Research on Car Cooling System Components	212,46				
Intecha, spol. s r.o.	Analysis of Hydrocyclons	17,11				
Stavebniny HOSANA spol. s r.o.	CFD Simulation of Turbomachines	9,07				
FANS, a.s.	Direct Air Condensation	7,26				
Společnost pro výzkum	Validation of a CFD Model	6,25				

ŠKODA AUTO a.s.	A Condensed Water Drain	7,99				
ŠKODA AUTO a.s.	Design of a Test Setup	8,84				
ŠKODA AUTO a.s.	Design of an Oil Separator	8,91				
Mavel a.s.	A comparison of water pump design using the 2D and 3D Panel Method and CFD Simulation	4,36				
ŠKODA AUTO a.s.	An Investigation of the Components of a Car Cooling System		178,91	344,45	84,21	
Electrolux, s.r.o.	Support for Electrolux Product Design		52,84	43,76		15,15
ŠKODA AUTO a.s.	An investigation of the parameters of a Car Cooler		17,93			
ŠKODA AUTO a.s.	Temperature Effect within a Car Engine Compartment		21,87			
ŠKODA AUTO a.s.	Intercooler Test Bench		7,27	8,02		
Doosan Škoda Power s.r.o.	Model of a Water Steam Vacuum Pump		1,83	14,52	12,13	
Pavel Tošovský	Propeller Design		8,27			
Mavel a.s.	Design of Sections of a Water Turbine		4,40			
Škoda motorsport	An investigation of the Airflow through a Cooler		8,92			
Continental Automotive	Design of a Power Assistant System			9,16	0,67	
AERO Vodochody AEROSPACE a.s.	Experimental Setup for Aero Vodochody			77,58	3,34	
ŠKODA AUTO a.s.	Modification of a Multi - Purpose Separator			7,43		
NAFIGATE Corporation, a.s.	The setup for long-term ageing tests on an Air Filter			4,49		
Intecha, spol. s r.o.	Measurements of the efficiency of a hydrocyclon			3,87		
Mavel a.s.	Preliminary design of a water turbine			4,27		
Gastro Production s.r.o.	Research on the heat losses of a cooling box				5,26	
Nami-Trade, s.r.o.	Heat and Mass Flow Measurement				4,71	

MYPLAST s.r.o.	An investigation of cooling tower fills					22,23
Brentwood Europe s.r.o.	Drift test at CTU					20,93
VVV MOST spol. s r.o.	Hose conveyor - straight part	3,63	4,40	3,82		
Pragometal, spol. s r.o.	Verification of test stand functions		4,70			
IMATECH GROUP s.r.o.	Testing an idler for a conveyor belt		4,29			
Bednar FMT s.r.o.	Design of a belt conveyor for an agricultural trailer	9,81				
Wikov Industry a.s.	Development of a built-in strain gauge apparatus for measuring gear mesh quality in industrial planetary gearboxes	45,07				
Noen, a.s.	Caterpillar chassis modeling	9,81				
Modřany Trade, s.r.o.	Software for calculating the strength of gate valves and pressure locks	9,81				
STS Prachatice, a.s.	Testing equipment for electrohydraulic systems	10,73	7,98			
Pontex, spol. s r.o.	Modernization of the boat lift - Orlík Waterworks	4,00				
ZVVZ MACHINERY, a.s.	Fan blade turn mechanism design	4,72	6,60			
MEDIROL s.r.o.	Analysis of the suitability of the material-composite fork travel		6,60			
PANAWORKS, s.r.o.	Mechanism inside a bicycle stem		4,58			
Wikov Industry a.s.	Design Verification of an Intermeshing Mixer Gearbox		7,33			
Hlavní město Praha	Elaboration of an explanatory report for the announcement of a tender for reconstruction of lifts			6,84		
STROS-Sedlčanské strojírny, a.s.	Lift research			15,17		
PREOL a.s.	Transmission failure analysis			10,17		
EKOEFEKT a.s.	A proposal for a new technical solution of the construction and drive fo the separation of a fuel			4,44		

	tank from the combustion space in an automatic brown coal boiler					
HENNLICH, s.r.o.	Tests on shaft seals					5,65
Dekonta a.s.	A mobile modular box system for on-site use					5,85
United Energy, a.s.	Model analysis and experimental analysis of the recent efficiency of limestone utilization in CHP plant Komořany	16,34				
Uchytil s.r.o.	An evaluation of the thermal efficiency of a K4 fluidized bed boiler				6,39	
Žatecká teplárenská, a.s.	A study for the greening of coal boilers	5,59				
Glanzstoff-Bohemia s.r.o.	A study of equipment for environment-friendly disposal of odorous emissions	4,10				
Ostrovská teplárenská, a.s.	A study of the replacement of existing boilers by greener boilers fired by coal and biomass	4,36				
H & D Engineering spol. s r.o.	Reconstructing or modifying K3 and K4 boilers for use as multi-fuel boilers	10,90				
G.A.M. HEAT spol. s r. o.	Design and construction of a stand for measuring plate heat exchangers	10,05	6,39			
Teplárny Brno, a.s.	A review of the concept of large production units in CHP plants in Brno.		13,93			
Teplárna Otrokovice, a.s.	An assessment of the desulphurization process in the Otrokovice CHP plant			4,81		
ŠKO-ENERGO, s.r.o.	An assessment of the impact of an increased share of biomass co-combustion on CFB boilers in ŠKO-ENERGO, s.r.o.		8,28			
ČEZ, a. s.	Computer models of steam boilers		14,84			
Ventos Energy Solutions, a.s.	Software for the design of heat exchangers for waste heat recovery			4,44		

BRONSWERK HEAT TRANSFER	Laboratory measurements of the thermal characteristics of an air cooler				4,56	
Palivový kombinát Ústí, s.p.	A basic feasibility study for the use of hydric reclamation in the Ústí Region for energy purposes (pumped storage power plants)			73,72		
ČEZ, a. s.	Creation of computer models of pulverized coal fired boilers operated by ČEZ, a.s.			4,81		
ŠKO-ENERGO, s.r.o.	An assessment of the fuel change for the combustion of 100% biomass in the ŠKO-ENERGO fluidized bed boiler				22,47	
Škoda Praha Invest s.r.o.	The influence of changes in fuel parameters on the parameters and the emissions of a boiler in the Ledvice 660 MWe power plant				4,37	
Ventos Energy Solutions, a.s.	Ventos - Software for the design of heat exchangers for waste heat recovery				4,56	
Žatecká teplárenská, a.s.	Effective control of heat production in the Žatec heating plant					8,19
Teplárna České Budějovice, a.s.	An assessment of a new business concept for the České Budějovice heating plant after 2020				11,98	
ČEZ, a. s.	ČEZ - Tests with mercury capture from boilers in the Trmice heating plant					4,11
VEOLIA ČESKÁ REPUBLIKA, a.s.	Conversion of the Veolia K8 boiler for biomass combustion					4,87
ČEZ, a. s.	An expert study on available technologies for capturing Hg from flue gases					8,19
Policie ČR	An explosion of a steam boiler for sulfur combustion		5,78			
United Energy, a.s.	Availability of So2 limit = 180 mg / nm3 on tky ii boilers				11,69	

ENERGOTRANS, a.s.	Optimization of combustion, reduction of NOx and CO production				4,29	
Omega Teplote. Praha	Wet Stack – a condensation analysis				6,08	
EGAP, a.s.	Preparation of a technical feasibility study for the Yunus Emre-Adularya 2 x 145 MW thermal power plant				13,29	
ČEZ, a. s.	An analysis of the possibility of storing electricity into heat					5,08
Doosan Škoda Power s.r.o.	Shape modifications of the balancing slots in an impulse turbine with a drum rotor arrangement	16,71				
Doosan Škoda Power s.r.o.	An experimental investigation of the liquid phase of wet steam in a 1000 MW nuclear power plant steam turbine	9,90				
Doosan Škoda Power s.r.o.	An experimental investigation of the liquid phase of wet steam in a 1000 MW nuclear power plant steam turbine	8,79				
Doosan Škoda Power s.r.o.	An experimental investigation of the liquid phase of wet steam in a 1000 MW nuclear power plant steam turbine	5,35				
Doosan Škoda Power s.r.o.	CFD numerical simulations of the wet steam flow in the low pressure part of a 1000 MW nuclear plant steam turbine		8,43			
Doosan Škoda Power s.r.o.	An experimental investigation of the steam wetness in the L-0 stage of LPST at NPP Temelin		12,87			
Doosan Škoda Power s.r.o.	CFD numerical simulations of the wet steam flow in the low pressure part of a 1000 MW nuclear plant steam turbine		8,43			

Doosan Škoda Power s.r.o.	An experimental investigation of the steam wetness in the L-0 stage of LPST at NPP Temelin		12,84			
Doosan Škoda Power s.r.o.	CFD numerical simulations of the wet steam flow in the low pressure part of a 1000 MW nuclear plant steam turbine			17,02	28,69	
Doosan Škoda Power s.r.o.	Experimental investigation in a 1090 MW steam turbine			20,94		
Doosan Škoda Power s.r.o.	Experimental investigation of the steam wetness in steam turbines, and a numerical simulation of wet steam energy losses.				22,11	
Doosan Škoda Power s.r.o.	CFD numerical simulations of the wet steam energy losses in a 1000 MW steam turbine					27,41
E.ON České Budějovice	Transition phenomena in distribution systems				5,32	
INOMECH s.r.o.	Behavior of radiators for heating food casings		4,26			
MINIB, a.s.	Development of an induction unit			5,41		
Mondi Štětí, a.s.	Drying air balance while optimizing the operation of high-performance drying covers		3,78			
Kotrbatý V.M.Z., spol. s r.o.	Innovation of radiating panels for heating industrial areas			4,44		
Greif-akustika s.r.o.	Acoustic absorber measurements				5,69	
EXPO 2020	Development of a unit for extracting water from air					99,43
JVTP - Jihočeský vědeckotechnický park	Behavior analysis of the innovated radiator				5,70	
Devro, s.r.o.	A description of the collagen package production process with the use of mathematical modeling	6,40	19,18			
SMOLO a.s.	New design of an evaporator and a					17,55

	crystallizer for separating industrial salts					
Metrostav a.s.	Expert advice on a technical evaluation of a municipal waste classifier line					6,32
Zeměd. Výzkum	Laboratory verification of the purification of the fugate from a biogas plant	1,82	2,97	2,96		
Synthos a.s.	Analysis and optimization of the critical and weak points of a cooling plant					18,33
AQUACOMP HARD, s.r.o.	Identification of the operation parameters of a vacuum evaporator prototype	5,19				
Prokop Invest, a.s.	Laboratory tests on distillery flops and fugates	4,90				
Intecha, spol. s r.o.	An analysis of the process for separating coke particles from quench oil		5,31			
AQUACOMP HARD, s.r.o.	The basic design and operation parameters of vacuum evaporation with crystallization			5,36		
Tenez a.s.	Design and optimization of mixing equipment		4,58			
HENNLICH, s.r.o.	An analysis of the condenser of the OCR unit		4,36			
MEGA a.s.	Design of the drying technology for ionex particles		4,40			
KOVOFINIŠ s.r.o.	Design of the ejector for a vacuum evaporator			3,92	1,06	
Intecha, spol. s r.o.	Design and construction of a laboratory unit for coke particle separation			3,33	1,71	7,25
AMCON Europe s.r.o.	3D design of a container unit for thickening, separating and mixing sludge and chemicals			3,88		
Unipetrol a.s.	Design of a filtration unit for TEA solution			6,29		
T&T, Turnov s.r.o.	Analysis of the flow and distribution of air in the pattern chamber of a fusing line				4,04	
EGI	Design of the technology for producing				8,51	

	ethylglycole from PET waste					
MONTS s.r.o.	An investigation of the shaft sealing of an impeller for a pressure vessel				13,33	
Glanzstoff-Bohemia s.r.o.	Optimization of production processes, lines and equipment in an industrial plant for the production of artificial fibres				17,05	24,76
Průša	Design of a pilot plant for pre-treatment of PEI powder technology				9,12	
Polycasas	Optimization of the hydrodynamics of a coating system for treating transparent plates					6,63
Průša	An analysis of particle size distribution – the effect of reactor process parameters					5,83
ŠKODA AUTO a.s.	An experimental description of 6th gear behaviour			8,74		
ŠKODA AUTO a.s.	Measurements of the efficiency of gearboxes			4,91		
GKR STEEL s.r.o.	Mounting kit for the fifth wheel hitch for Nissan Navara				18,61	
ŠKODA AUTO a.s.	Development of a gear shifting mechanism				11,92	
Eaton Elektrotechnika s.r.o.	Simulation-based Engine Brake Concept Analysis and Optimization			26,26	12,93	
ÚAMK, a.s.	Roadside measurements of particle emissions from individual vehicles				3,41	11,90
ŠKODA AUTO a.s.	Heat Transfer in Internal Combustion Engines	4,16				
ŠKODA AUTO a.s.	Engine Testing Under Transient Conditions	33,40				
ŠKODA AUTO a.s.	Exhaust system development and testing	5,67				
ŠKODA AUTO a.s.	An experimental description of a modern manual gearbox	10,90				
ŠKODA AUTO a.s.	Engine Testing Under Transient Conditions	87,87	8,77			
ŠKODA AUTO a.s.	An experimental description of the behaviour of an engine	8,40				

	exhaust system, related to emission standards					
ŠKODA AUTO a.s.	Vehicle Simulation on an Engine Test Cell	25,22				
ŠKODA AUTO a.s.	Optimization of an engine intake manifold	8,90				
ŠKODA AUTO a.s.	Modification of a new separator concept		9,05			
SGS Czech Republic s.r.o.	The effect of fuel composition on engine parameters		5,35			
ŠKODA AUTO a.s.	An experimental description of 6th gear behaviour		8,77	8,85		
Eaton Elektrotechnika s.r.o.	Development of a data acquisition system		4,33			
ŠKODA AUTO a.s.	Energy Balance of an IC Turbocharged Engine				23,38	
VarioTec s.r.o.	Simulation and testing of a two-stroke engine					19,83
ŠKODA AUTO a.s.	Mass balance of the water component in an MQB separator		8,63			
ŠKODA AUTO a.s.	An experimental description of joint shaft temperatures				6,02	
ŠKODA AUTO a.s.	Development testing of joint shafts				11,37	
ŠKODA AUTO a.s.	An experimental description of final drive behaviour					9,86
ŠKODA AUTO a.s.	Carsharing for college students			7,73	34,57	58,42
ŠKODA AUTO a.s.	A methodology for transient testing of a small SI engine		31,51			
ŠKODA AUTO a.s.	Transient testing of a small SI engine		31,92			
ŠKODA AUTO a.s.	Tests on the exhaust gas system of an SI engine		5,50			
ŠKODA AUTO a.s.	Carsharing for college students		13,01			
Seven Energy	Laboratory and on-road evaluation of the emissions from light-duty commercial vehicles powered by compressed natural gas			30,61		
ŠKODA AUTO a.s.	Heat balance of an SI engine			17,76		

ŠKODA AUTO a.s.	Development of the control strategy for a hybrid vehicle			4,34		
TEDOM a.s.	An evaluation of the exhaust gas composition from a cogeneration unit				11,90	
ŠKODA AUTO a.s.	The temperature behavior of a vehicle in the driving cycle and during conditioning				44,91	
ADW	Design of an internal combustion engine				12,25	
ŠKODA AUTO a.s.	Simulation model of a natural gas combustion engine				9,33	
SGS Czech Republic s.r.o.	Behavior analysis of the injection system of an SI engine				5,33	
TEDOM a.s.	A model and experimental description of combustion engine properties for a CHP unit				9,10	
ŠKODA AUTO a.s.	R&D activities on the chassis dyno-thermal behaviour of vehicles					60,23
Ricardo Prague s.r.o.	Measurements of the ZS engine on a roller / Measurements of the ZS engine test bed					15,76
SGS Czech Republic s.r.o.	An experimental description of a turbocharged SI engine in various regimes					4,71
Národní centrum competence Josefa Božka pro pozemní dopravní prostředky TN01000026 /01	Integrated Contribution from the Commercialization of Research Results for Automotive and Rail Vehicle Engineering (Škoda Auto, Škoda Transportation, Zetor, etc.)					300,14
Honeywell, spol. s r.o.	Simulation of Turbocharged Engines	14,37				
Strojírny Bohdalice, a.s.	Model-based Optimization of a Stirling Engine	5,01				
ŠKODA AUTO a.s.	Vehicle A-box model	8,81				
ŠKODA AUTO a.s.	Fluid flow visualization	9,03				
ŠKODA AUTO a.s.	Emulation of Vehicle Driving Cycles, using the Engine Test Cell	50,80				

JIHLAVAN airplanes, s.r.o.	Research on the strength parameters of the JA-400 all-metal low-wing airplane			5,55	18,99	
Direct Media s.r.o.	Conceptual design of an airplane			27,82		
LPS Automotive, s.r.o.	Development of a drone for inspecting linear structures					20,93
Roko Airplanes s.r.o.	Conceptual design of an ultralight airplane					17,85
UNEX a.s.	Technology transfer for UNEX IVT foundries	94,39	21,38			
ProSpon spol. s r.o.	Experimental tests on the material properties of samples 3D printed from titanium alloy Ti6Al4V				3,80	7,02
Moravskoslezský automobilový klastr	High-strength steels for components in the automotive industry		59,67			
METAL TRADE COMAX, a.s.	A technological audit of heat losses			7,62		
SŽDC - Správa železnic	Research on the corrosion protection of bridges and steel structures		22,91			
LCV Praha, s.r.o.	Development of the polishing and marking of steel surfaces by a fiber laser		4,58			
ŠKODA AUTO a.s.	Research on the weldability and formability of steels and sandwich materials			10,56		
ŠKODA AUTO a.s.	Weldability tests on high strength steels (22MnB5) with an Al-Si coating, used in the automotive industry.					
Metalurgie Rumburk, s.r.o.	2015 - Typing elements during technological operations of the forming process, 2016 - Casting molding technology for machine tools of the parent company, 2017 - Optimization of fettling operations, a proposal		4,85	5,62	5,89	

	for an endoscopic inspection of castings					
Slévárna Chomutov, a.s.	2015 - Development and verification of 3D printing technology for small models on own 3D equipment, 2016 - Development and design of changes in machine casting technology, Hollotex verification, 2017 - Design of innovative technology and equipment for the heat treatment set of manganese steels 2018 - Operational verification of the efficiency of innovated equipment for TZ in year-round climatic conditions		5,51	5,56	5,71	8,85
IEG s.r.o.	2016 – An analysis of knowledge about the production of precision LLG castings, 2017 – Developing the technology for the LLG heavy casting “carrier”, 2018 – Verification of the prototype for “carrier” production			8,51	3,42	4,17
Industrial Engineering Group s.r.o.	2016 - Isothermal hardening of LKG castings, and use of the hardening complex for other types of cast iron and steel, 2017 - Conditions and principles of LKG heat treatment to ADI values, 2018 - Heat treatment processes for castings and wrought aluminum alloys			4,44	3,04	7,80
Saint Gobain PAM CZ s.r.o.	2017 - Development of technology and operating standards for repair welding of valve castings, 2018 - Verification and confirmation of molding compound parameters for the AFL molding line				1,14	5,07

Buzuluk a.s.	2018 – An investigation into the causes of cracks in the roller top shaft					6,63
Ředitelství silnic a dálnic ČR	An assessment of the suitability of the steel structure of bridge SO 202 on the D47 motorway		5,43			
DIRAC Industries s.r.o.	Design and verification of tube ejection technology			4,62		
Kerval a.s.	Improvements to the fixation system for korundo baddeley tiles				9,40	
METAL3D s.r.o.	An analysis of parts produced by 3D printing				9,42	
Kerval a.s.	High-strength steels for components in the automotive industry					19,24
CTIV	Research on surface treatment and welding	5,98	8,54	8,59	10,35	2,67
S.A.F. Praha spol. s r.o.	Research on abrasion resistant materials	7,01				
Ředitelství silnic a dálnic ČR	Diagnosis of corrosion protection for the internal surfaces of arches			16,42		
Kornet s.r.o.	An assessment and the development of a new forming technology					15,56
Kornet s.r.o.	Production of metal stampings					6,63
Lovochemie, a.s.	Greening of the Energy Source in Lovochemie, a.s				20,88	
Ředitelství silnic a dálnic ČR	Research in the field of corrosion and corrosion attack				3,72	12,42
Synthesia a.s.	Greening of the energy source in Synthesia,a.s.				19,75	
Svářečská škola	Design and testing of welding procedures		4,89	0,18	1,92	
ČEPS Invest, a.s.	Tests on steel construction elements			5,97		
IWT,EWT	Development and testing of a carbon plate	8,82	12,55	4,65	1,93	
SOPO s.r.o.	Schneider Electric ACM3 optimization of the production technology for segmented stators in division 003			9,93	16,41	18,02
Schäfer - Menk s.r.o.	Research on the technical-organizational				70,30	74,27

	level of the production processes in Schäfer-Menk s.r.o. - Rationalization of production, Development of a dry machining process					
Doosan Bobcat Engineering s.r.o.	Design of the prototype production layout in Doosan Bobcat Engineering s.r.o.				5,23	3,08
Carl Zeiss spol. s r.o.	Contractual research for the industrial metrology division of Carl Zeiss - development of automated quality inspection systems for the automotive, aerospace, transportation, medical and energy industries. This involves inspection plans, CMM programming, the design of fixtures and production and process qualification at the customer site.	22,39	61,88	60,95	56,36	42,69
P-D Refractories CZ, a.s.	P-D Refractories CZ - Development of the HVOF removal method		4,20	5,88	3,86	
SOPO s.r.o.	SOPO - Production Process Optimization in SOPO s.r.o.		21,99	6,47		
Mikronex, s.r.o.	Development of grinding process parameters, fixtures and programming for a special grinder for automated production of glass files and raspers		6,37	11,33		
Schäfer - Menk s.r.o.	Research on the technical-organizational level of the production processes in Schäfer-Menk s.r.o. - Rationalization of production, Design of the layout and the material flow of a new production site			20,59		
VIA ALTA a.s.	Development of Integrated Logistical Support for the supply of			21,39	14,72	30,04

	special bridge cranes for the Jules Horowitz Reactor in Cadarache (FMEA, FMECA, SIL)					
ŠKODA AUTO a.s.	An analysis of modern approaches to the maintenance of production systems, and their applicability in the context of Škoda Auto (Maintenance 4.0)				15,45	3,30
GE Aviation Czech, s.r.o.	Development of residual stress measurements on turbine airfoils 2014-2017	21,79	22,50	16,31	10,92	
Attl a spol. s r.o	Optimization of laser welding and forming of stainless steels			3,53	5,24	5,28
Kerval a.s.	Optimization of the door frame manufacturing process					5,65
BLUE RAY a.s.	Design of individual machine nodes, analysis and optimization.	22,23	29,03			
TOOL AXIS s.r.o.	Constructional modification of a machine			10,36		
JIHLAVAN airplanes, s.r.o.	Flutter analysis of the GP ONE aircraft	4,81				
Rokospol Aviation s.r.o.	Flutter analysis of VIA NG UL and VIA NG4 LSA aircraft		5,15			
Ivanov Aircraft	Research on the load capacity of the composite wing of Explorer aircraft		4,76			
LA Composite, s.r.o.	Research on selected material characteristics of composite materials		3,98			
Doosan Bobcat Engineering s.r.o.	Fatigue analysis of welding joints		13,93			
LA Composite, s.r.o.	Research on selected material characteristics of composite materials			3,95		
HPH, spol. s r.o.	Flutter analysis of EB29R aircraft			5,50		
HPH, spol. s r.o.	Flutter analysis of EB29R aircraft				6,91	
HPH, spol. s r.o.	Flutter analysis of TWIN SHARK aircraft					6,48

ZALL JIHLAVAN airplanes, s.r.o.	Flutter analysis of JA-600 aircraft					6,76
Národní centrum kompetence - NCK TN01000008 /06	VERTICAL ADAPTER - design calculations of several spindle variants					15,56
Národní centrum kompetence – NCK TN01000008 /06	Design of technical concepts for an automatic process. Processing conceptual topics for the technical solution of the head. Evaluation of proposals. Processing of an overview report					4,68
PBS Turbo s.r.o.	Analysis of the technology and the creation of an impeller prototype	10,85	29,30	0,64	9,75	
PBS Energo, a.s.	Modeling and production of impeller blades	20,91	11,64	7,01	23,53	
ITS s.r.o.	Cooperation with ITS on CNC software - cycle library simulation	2,03	1,91	0,92		
ATEKO a.s.	Analysis of the technology and the creation of an impeller	48,81	8,97	28,60	19,25	
SOMA spol. s r.o.	Analysis and measurements of the thermal behavior of the ZAYER machine and the temperature conditions in two production halls.	4,63		11,44	7,42	
Flexicat s.r.o.	Development and production of a prototype of a multi-wheel hand grinder	5,45				
KOVOSVIT MAS a.s.	Development of construction nodes, including technological parameters	129,03	172,09	170,11	99,14	85,04
CODA DEVELOPMENT s.r.o.	Development of machine nodes, including technological parameters	4,01				
DAM Ústí nad Labem s.r.o.	Construction designs	25,55	11,00			
Zkušebna VUOS, s.r.o.	An analysis of the thermal deformation of	12,75				

	the supporting structure of the Jupiter machine with a polymer concrete bed					
Pittsburgh Corning CR s.r.o.	Vibration analysis	3,79				
BLUE RAY a.s.	Computational designs of machine nodes, analyses of drive settings	3,92	13,92	12,70	1,29	
LAMMB technology s.r.o.	Development and structural design of a headstock and a spindle	17,58	4,83	4,33		
Mavel, a.s.	Development of computational and optimization procedures for a water turbine casing		0,73	1,63	12,53	
JNC construct s.r.o.	Optimization of a horizontal milling machine and the design for a carousel		24,58			
TOOL AXIS s.r.o.	Design and calculation analyses of machine nodes, technological support in the field of drives and postprocessors		6,03	2,84	13,99	16,16
GRUND a.s.	Modification of the construction of a twelve-needle machine for testing the principle of creating a 3D carpet structure with variable pile length		9,16	7,06		
TOSHULIN, a.s.	Design of optimized hydrostatic guidance of the x and y axis of the FORCETURN 4000 machine, optimization of the frame rigidity of Powerturt 1000 III		2,28	3,48	11,17	
Jihočeský, a.s. VEDE	Provision of development services within innovative vouchers		5,13	14,98	11,58	5,81
Nomatech s.r.o.	A conceptual study of modifications to the kinematics of the drive of the BHV 250C machine			3,11	4,33	
VTL Blansko, a.s.	Measurements and analysis of the operating parameters of hydrostatic lines		5,98			

BAEST Machines & Structures, a.s.	Calculation of tanks				7,60	
KMB systems s.r.o.	Innovation of the ENVIS software environment			4,00		
ROKA Industry, spol. s r.o.	Innovation of cutting machine cross member design, including calculations			5,55		
RETOS VARNSDORF s.r.o.	WH10CNC headstock analysis and measurements			3,93	2,38	
Hestego a.s.	Computational and design analyses of telescopic covers. Analyses of samples of damping materials	0,49	7,93	0,40		
KDK Automotive Czech s.r.o.	An analysis of the large dispersion of armrest folding forces. The state of the production and assembly of the armrest		4,09	13,19		
Národní bezpečnostní	Development of a system for controlling tested devices during TEMPEST measurements in a shielding measurement chamber	1,21	0,92	9,58	5,78	
Strojírna Tyc. s.r.o.	Design and calculations for spindle heads				1,33	15,56
Meopta - optika, s.r.o.	A pre-design study of the centric head					4,68
TRATEC-CS s.r.o.	Technical design solutions, strength calculations of machine construction nodes	13,58	12,73	16,10	5,28	0,35
Slovácké strojírny, a. s.	Development and realization of a multifunctional grinding machine	0,44		2,96	0,91	37,27
TOS KUŘIM - OS, a.s.	Optimization of the construction of a 16 m carousel, and the development of machine construction nodes	71,04	43,07	43,87	9,83	
Erwin Junker Grinding Technology a.s.	Computational analysis of construction nodes	99,79	20,81	6,57	8,23	11,46
Kornet s.r.o.	Cooperation in the MIT Potential project	10,90				

FRONTIER TECHNOLOGIES, s.r.o.	Development of new design and construction of LED lighting			0,81	7,88	
TOS VARNSDORF a.s.	Computational analysis of machine construction nodes			32,27		
ALTA, a.s.	Development and visualization of "16m" machine design			5,06		
OCHI - INŽENÝRING, spol. s r.o.	Development of a mathematical - simulation model for determining the kinematic - dynamic parameters of multiaxial drives			12,21		
TGS nástroje-stroje-technologické služby s.r.o.	Development of the design, construction and drawing documentation of a mobile kitchen unit for the production hall			4,39		
ČKD BLANSKO-OS, a.s.	Diagnostics and analysis of the occurrence of vibration when the SKD 40 / 47D machine is tuned on	5,20	1,43			
Dormer Pramet s.r.o.	Technological tests	19,05	29,60	20,14	7,16	
Kistler Eastern Europe s.r.o.	Design of an algorithm and realization of a software application for measuring the torque of rotating tools with the use of stationary dynamometers	9,66		4,44		
Continental Barum s. r. o.	Automated borehole drilling to great depths for aluminum alloy production	4,67				
SHM, s. r. o.	Performing cutting tests by milling to verify the effect of surface treatments	8,17			4,48	4,88
Technologické centrum	Measurements of cutting forces. Analyses of deformations and static stiffness. Analyses of drive settings.			3,20	0,53	0,58
Lehman René	Optimization of the production technology for composite parts	2,18	1,83	4,19	6,74	
VINCI Facilities	Optimization and changes in the design of		3,71			

Česká republika, s.r.o.	of the machining technology for plastic parts					
Rupet formy a modely s.r.o.	An analysis of the existing process of deep drilling and power milling of aluminum alloys			6,40		
Mosled, s.r.o.	An analysis of the technology and the machining of a turbine and a pump wheel			3,89		
ROTANA a.s.	Development and testing of tools for milling nickel alloys			2,92	6,50	
Unicut s.r.o.	Analysis and functional tests on milling tools	0,74	1,20		3,61	
BEZNOSKA, s.r.o.	An analysis of the technological parameters for the production of stainless steel components		3,02	3,35	9,12	
SANBORN, a.s.	Debugging and selection of optimum cutting conditions on a specified material			9,82		
Sandvik Chomutov Precision Tubes s.r.o.	Selection and optimization of a suitable technology for the production of pipe ends		6,43			
SAHOS a.s.	Drive analysis and tuning	17,03		3,95		
Linde Gas, a.s.	Measurements and analyses of turbocompressor vibrations	1,47	1,09	2,95	1,95	
GE Aviation Czech, s.r.o.	Design of production technology and production assurance (in three variants) of prototype parts			4,94	24,31	
v-tech, s.r.o.	Creation of an SW adapter for the Heidenhain iTNC530 control system for communication via the Mtconnect protocol					12,26
Štěpánek Libor	Development of a postprocessor and a simulation model for a CNC milling machine tool		6,43			
PULS investiční s.r.o.	An assessment of ways to automate the marking, packaging and dispatch process					5,38

KOVOSVIT MAS, a.s.	Computational support for the design of the internal structure of a machine				11,81	
TRATEC-CS s.r.o.	Designs, models and visualizations				6,32	
TOS KUŘIM - OS, a.s.	Computational support for structural designs				18,23	
KOPOS KOLÍN a.s.	Preparation of computational models for ANSYS software					4,59
	316 other research tasks	155,98	215,21	181,99	149,55	155,26
Total		1719,32	1707,51	1810,31	1448,08	1593,54

Note: List and describe contract research work with the revenue for the calendar year in question.

3.3.2 Research work contracted by a foreign client

Client	Research title	Revenues (EUR thousand)				
		2014	2015	2016	2017	2018
Volkswagen	Design and Callibration of an Experimental Flow Meter for Wind Tunnel Tests.		7,92		10,54	
Electrolux Italia	Operation of a joint Electrolux – CTU Prague Technology Centre					32,87
Brentwood Industries	Research on Fluctuations in the Parameters of Cooling Fills due to Ageing	7,54				
Sorbeum Enviro	Design of an Adsorbtion Cooling System		6,33			
Volkswagen	Design of Pressure Tabs			10,26		
North-West University	Advanced High Temperature Reactor cycle optimization for a 100MWt He-cooled reactor			13,92	38,28	
Doosan Heavy Industries	Development of a Supercritical Carbon Dioxide Cycle for Waste Heat Recovery		71,90	69,27		
University of Pécs	Energy consumption of buildings	9,96				
Amot	Market study for a no-leakage G valve			3,90		
Joint Research Centre	MiniPEMS - Miniature on-board portable emissions monitoring system			13,79		
TNO	Measurements of the exhaust emissions of small motorcycles				4,91	
Jaguar	The turbocharging pulse factor as an important accuracy improvement for turbocharger matching	20,48				
KIMM HGM	Heat generation modelling and experimental analysis for an oil-air lubricated angular contact ball bearing; Development of a thermal analysis module for spindle design with angular contact ball bearing				37,70	

TRENS SK, a.s.	Measurements of the temperature behavior of the turning center, and the creation of a compensation algorithm for the temperature errors of the machine in the x axis, design sweeps			5,70		
FMC Kongsberg Subsea	Shah Deniz II. simulation and optimization	312,43	69,13			
EMCO GMBH	FEM Analysys of old and new HT45 turning centers in two kinematic configurations					21,59
SOLIDCAM LTD.	Development of a special methodology for suppressing chatter vibration in milling		26,51			
RODERS GMBH	Simulation analyses of the cross slide and the spindle stock of the RXU1000 machine tool	16,11				
KONSTRUKTA INDUSTR.	An audit of the technology for cutting and compression line products	9,30	0,66			
DOOSAN MACHINE TOOLE	A project proposal for developing a thermal error compensation model of the DOOSAN VC 630/5Ax machine tool. Tests on the model.					36,29
	3 MORE RESEARCH TASKS	2,41				1,26
Total		378,22	182,44	116,84	91,43	92,01

Note: List and describe contract research work with the revenue for the calendar year in question.

3.4 Revenues from non-public sources (besides grants or contract research)

3.4.1 Overview of revenues from non-public sources raised for the 2014–2018 reporting period

Revenue type	Revenues (EUR thousand)				
	2014	2015	2016	2017	2018
A gift for the development of cooperation between the endowment and the company	1,82				
Gift for a student competition		0,92			
Gift from dr. Thomas Morel - According to point I. – of CZK 18 023 600,- for supplementing the testing equipment and in support of basic research to improve the efficiency, the environmental impact, and the control of the heat mode (cooling and heating) for electric, hybrid or internal combustion engine slack				809,75	
Gift from a GE Collaborative Contract				569,69	1739,27
Gift in support of experimental research on the characteristics of a two-entry turbine turbocharger			14,80		
Gift in support of the development of a 1D model radial turbine turbocharger	18,16	7,33			
Gift in support of STČ	0,64	3,56	2,66	2,54	2,22
Giftin support of the creative activities of the CTU Cartech student team	41,27	52,41	47,61	42,61	28,62
Gift to cover a part of the cost of participating in a workshop				2,28	
Gift to cover the costs of conferences	2,91				1,75
Gift to finance education and science		3,67	3,70		
Gift for the acquisition of a control sensor for an open test institute in the CVUM FS CTU laboratory					6,63
Gift for the acquisition of preheating and annealing resistance equipment for plasma welding during a controlled temperature cycle				9,47	
Gift for the acquisition of a telemetry multichannel kit					9,75
Gift for the construction of new equipment for testing shifting mechanisms					9,75
Gift for research on sheet weldability for the production of automotive bodywork				9,49	
Gift to fund science, education and the all-round development of CTU in Prague, Faculty of Mechanical Engineering, Institute of Environmental Technology	1,82	0,73	4,96	5,89	6,92
Gift for the purchase of sensors and measuring cards to extend mounting vibration diagnostics		5,86			
Gift in support of the Department of Energy Ú 12115, mainly to finance science, education, professional travel and research, development and teaching		0,37			
Gift in support of the Department of Energy Ú 12115, mainly for financing science, education, professional travel and research, development and teaching	3,67				
Gift in support of the scientific activities of students of the Institute of Process and Processing Technology	0,73				
Gift in support of research and education for students	7,26				
Gift as a contribution to the implementation of the project on extending the experimental background of the Institute of Fluid Mechanics and Thermodynamics			9,11		

Gift for reconstruction of the aerodynamic tunnel – the installation of an air conditioner to enable air current temperature control		7,20			
Gift to develop the research base of the Institute of Production Machinery and Equipment		3,67			5,85
Gift to reimburse part of the costs for reconstructing the measuring laboratory for education and research			6,59		
Proceeds from the License Agreement to the MPO FR-TI1/047 Project (Composite Surface Finishes)				5,70	
Proceeds from the license agreement to avg. model No. 26034 (Neutron camera)		3,09			
Revenue from the contract for the use of results achieved under TAČR project TA02011251 (Optimization of enamelled mixing equipment)			1,07		
Revenue from the contract for the use of results achieved under TAČR project TA02011367 (New type of pressing mould and protective coating)			6,42	15,26	9,79
Revenue from the contract for the use of results achieved under TAČR project TA03010844 (Surface Treatment Technology)				0,08	0,02
Revenue from the contract for the use of results achieved under TAČR project TA04010600 (Force grinding technology)					2,14
Revenue from the contract for the use of results achieved under TAČR project TA04020658 (Functional sample of tricanter)				0,97	
Revenue from the contract for the use of results achieved under TAČR project TE01020020 (Turbocharger)				0,45	0,89
Revenue from the contract for the use of results achieved under TAČR project TA02010243 (Mixing equipment for sludge processing)		0,73			
Total	78,28	89,54	96,92	1474,18	1823,60

Note: List funds for R&D&I from non-public sources, besides grants or contract research (e.g. licences sold, spin-off revenues, gifts, etc.) in each calendar year.

3.5 Applied research results with an economic impact on society

3.5.1 Overview of applied research results in the 2014–2018 reporting period

List and describe the results that have already been applied in practice, or that will realistically be applied, with an existing or prospective economic impact on society. Under “patents” and “licences sold”, list all the results; under other results list a *maximum* of five items. Unless otherwise specified below, the definition of a result must correspond to the definitions under the Methodology for Evaluating Research Organisations and Research, Development and Innovation Purpose-Tied Aid Programmes, Appendix No 4: Definitions of Types of Results.

Results	Year	Title
European patent		
EP 2732928B1	**2018**	REDUNDANT DELTA MANIPULATOR
EP 3183098B1	**2018**	A DEVICE FOR CONTROL OF A SPHERICAL MOTION OF A BODY
American patent		
US 9364932	**2016**	DEVICE FOR A BODY'S SPHERICAL MOTION CONTROL

US 9358646	**2016**	SUPPORTING STRUCTURE FOR REPOSITIONABLE AND RECONFIGURABLE MANIPULATING ARMS
US 9297332 B2	**2016**	CYLINDER HEAD WITH ANNULAR VALVE FOR INTERNAL-COMBUSTION ENGINE
US 10139327 B2	**2018**	INDENTATION DEVICE, INSTRUMENTED MEASUREMENT SYSTEM, AND METHOD FOR DETERMINING THE MECHANICAL PROPERTIES OF MATERIALS BY THE INDENTATION METHOD
Czech licenced patent		
CZ 305435 Licence UCHYTIL s.r.o., Brno, CZ	**2015**	FLUIDIZED BED FURNACE AIR DISTRIBUTOR
Other foreign patents		
Russian Federation, RU 2538038	**2014**	ELECTRONIC CIRCUIT FOR THE EVALUATION OF INFORMATION FROM VARIABLE ELECTRIC RESISTANCE SENSORS
China, Patent CN 105143721	**2017**	AN APPARATUS FOR OPENING AND CLOSING A LID PIVOTALLY CONNECTED TO A FRAME, ESPECIALLY A CAR BOOT LID
Licences sold		
Utility Model CZ 26034 Licence TVARMETAL s.r.o.	**2015**	NEUTRON CAMERA
Utility Model CZ 26644 Licence TECHMIX s.r.o.	**2015**	MIXING DEVICE FOR HOMOGENIZATION OF HETEROGENIC SUSPENSIONS
Utility Model CZ 28216 Licence TECHMIX s.r.o.	**2015**	DEVICE FOR EFFICIENT HEATING AND COOLING IN LONG VESSELS
Utility Model CZ 28341 Licence TENEZ a.s.	**2016**	AGITATING DEVICE, ESPECIALLY FOR ENAMELED APPARATUSES
Utility Model CZ 25123 Licence TENEZ a.s.	**2016**	AXIAL HYDROFOIL IMPELLER FOR ENAMELED APPARATUSES
Contract on utilization of results – project TA02011367 Licence P-D Refractories CZ a.s.	**2015**	RESEARCH OF PRESSING TOOLS SERVICE LIFE EXTENSION FOR REFRACTORY HIGHLY ABRASIVE MATERIALS
Contract on utilization of results – project TA04010600 Licence První brněnská strojírna Velká Bíteš, a. s.	**2017**	ADVANCED TECHNOLOGY DEVELOPMENT OF HIGH POWER GRINDING FOR DYNAMICALLY LOADED PARTS FROM HARD-TO-MACHINE SUPER-ALLOYS FOR POWER AND AERONAUTICS INDUSTRY WITH RESPECT TO SURFACE INTEGRITY
Contract on utilization of results – project TA04020658 Licence První brněnská strojírna Velká Bíteš, a. s.	**2017**	RESEARCH AND DEVELOPMENT OF MOBILE TRICANTER DESIGN AND MANUFACTURING TECHNOLOGY
Contract on utilization of results – project TE01020020 Licence ČZ a.s.	**2017**	JOSEF BOZEK COMPETENCE CENTRE FOR AUTOMOTIVE (DESIGN, CALCULATION AND SIMULATION OF TURBOCHARGER)
License agreement – project MPO FR-TI1/047 Licence CVP Galvanika, s.r.o.	**2016**	COMPLEX AND ENVIRONMENTAL TECHNOLOGIES OF COMPOSITES SURFACE TREATMENT DEVELOPMENT BASED ON ZINC WITH LOW FRICTION COEFFICIENT (COMPOSITE SURFACE TREATMENT)
Contract on utilization of results – project TA03010844 Licence PRAGOCHEMA spol. s r.o., Czech Airlines Technics, a.s.;	**2014**	DEVELOPMENT OF SURFACE TREATMENT TECHNOLOGIES WITH LOW DEGREE OF HYDROGEN INGRESS

Software copyright licences (author: doc. Ing. Tomáš Dlouhý, CSc.) - Ventos s.r.o.	**2016**	SOFTWARE FOR THE DESIGN OF HEAT EXCHANGERS FOR HEAT RECOVERY
Significant analyses / surveys / studies		
Research Report	**2015**	Dlouhý, T.; Hrdlička, F.; Hrdlička, J.: ASSESSMENT OF BIOMASS CO-COMBUSTION INCREASE ON FLUIDIZED BED BOILERS OPERATION IN THE SKO - ENERGO CHP PLANT
Research Report	**2016**	Krátký, L.; Jirout, T.; Moravec, J.; Štancl, J.; Skočilas, J.; Žáková, T.: REVIEW OF NLGG VALVE POTENTIAL FOR ITS APPLICATION IN SELECTED INDUSTRIES FOR AMOT UK
Research Report	**2016**	Kudláček, J.; Zoubek, M.; Svoboda, J.; Drašnar, P.; Pakosta, M.; Kreibich, V.: THE DIAGNOSTIC SURVEY OF INNER SURFACES COATINGS OF THE BRIDGE ARCHES N. 19-028, INCLUDING CHEMICAL ANALYSIS OF USED COATINGS
Research Report	**2016**	Beránek, L.; Fuchs, P.: DEVELOPMENT AND DOCUMENTATION OF ILS SYSTEM FOR HANDLING CRANES IN HOT CELLS, RELIABILITY ANALYSIS AND RELIABILITY
Conference paper describing an application study	**2017**	Valášek, M.; Steinbauer, P.; Šika, Z.; Neusser, Z.: PROBLEMS, SOLUTIONS AND USAGE OF SHOCK ABSORBERS WITH DEGRESSIVE CHARACTERISTICS In: Proceedings of the 25th International Symposium on Dynamics of Vehicles on Roads and Tracks. Rockhampton: Central Queensland University, Rockhampton, Queensland, Australia, 2017
Spin-off with a stake held by the evaluated unit		
Spin-off with no stake held by the evaluated unit		
Prototypes		
	2015	Theiner, R.; Brabec, J.; Barák, K.; Kučera, J.; Helmich, M.; Sommer, T.; Malásek, T.; Čenský, T.: ULTRALIGHT AIRCRAFT UL-39 ALBI
	2015	Černý, J.; Novotný, C.; Doubrava, K.; Martunů, M.; Pavlata, P.: 1ST PROTOTYPE OF SANDWICH ROOF FOR EBN11 VEHICLE
	2016	Síbr, M.; Čejka, Z.; Růžička, P.: PROTOTYPE OF ACETABULUM REPLACEMENT
	2017	Hrdlička, F.; Dlouhý, T.; Hrdlička, J.; Sova, J.; Doubrava, K.: PROTOTYPE OF A NON-WOODEN BIOMASS BOILER
	2017	Krátký, L.; Jirout, T.; Procházka, P.: VARIABLE UNIT FOR LIQUID AND SOLID PHASE SEPARATION
Varieties and breeds		
Other		
Verified Technology	**2017**	Falta, J.; Sulitka, M.; Janota, M.; Kohút, P.; Smolík, J.; Frkal, V.; Stříteský, P.: PROVEN TECHNOLOGY -

		TOSHULIN - 2017: IMPROVING THE QUALITY OF MACHINING OF THIN-WALLED PARTS
Functional Sample	**2017**	Cvrček, L.; Denk, F.; Čejka, Z.; Unucka, P.; Gallo, J.; Joska, L.: ORTHOPEDIC REPLACEMENT OF THE KNEE JOINT VEKTOR
Conference paper describing practical results	**2017**	Valášek, M., Kovář, F.: IMPROVED CALIBRATION OF MACHINE TOOLS BY REDUNDANT MEASUREMENT, In: Proceedings of the 8th ECCOMAS Thematic Conference on MULTIBODY DYNAMICS 2017. Praha: CTU PH. Production, 2017. p. 671-675.
Functional Sample	**2018**	Skočilas, J.; Hoffman, P.; Jirout, T. SPRAY DRYER TA ČR GAMA PP1 TG02010033
Software	**2018**	Tichánek, R.; Bolehovský, O.: COMPUTATIONAL MODELS FOR TWO STROKE ENGINE BRAKE SIMULATIONS

Note: "Licence" refers to a licence for a result of R&D&I in the broadest sense of the word (licences for patents, utility models, industrial designs; copyright licences for software and other works, and any other licences).

For the purposes of this methodology, a "spin-off" is a juridical person established to commercialise knowledge, usually with the inclusion/transfer of the rights to this knowledge to such juridical person. List all instances of legal persons.

3.6 Significant applied research results with an impact other than an economic one on society

3.6.1 Overview of applied research results for the 2014–2018 reporting period with an impact other than an economic one on society

Result type	Name	Anticipated impact
Research Report	Simeunovič, G.; Vyhlídal, T.: INDOOR CLIMATE ANALYSIS OF GREAT TOWER INTERIORS OF KARLSTEJN CASTLE, 2015.	Protection of indoor spaces and exhibited cultural monuments, especially historic paintings, and their preservation for future generations
Software	Zmrhal, V.: METHODOLOGICAL GUIDELINE FOR THE DESIGN OF SCHOOL VENTILATION – SOFTWARE, 2015.	Impact on children's health
Research Report	Dlouhý, T.: THE BASIC FEASIBILITY STUDY FOR THE USE OF HYDRIC RECLAMATION ON THE TERRITORY OF THE USTI REGION FOR ENERGY PURPOSES - PUMPED STORAGE POWER PLANT, 2016.	Impact on the environment, use of reclaimed areas after brown coal surface mining
Article	Vojtisek-Lom, M.; Beránek, V.; Klír, V.; Jindra, P.; Pechout, M.; Voříšek, T.: ON-ROAD AND LABORATORY EMISSIONS OF NO, NO2, NH3, N2O AND CH4 FROM LATE-MODEL EU LIGHT UTILITY VEHICLES: COMPARISON OF DIESEL AND CNG. The Science of the Total Environment. 2018, 616-617.	Impact on the environment, quality of life and human health
Article	Bíla, J.; Jura, J.; Novák, M.: APPLICATION OF FUZZY LOGIC FOR	Impact on the environment, the cooling effect of vegetation on the climate in large towns

	MONITORING OF APPEARANCE OF HEAT WAVES IN LARGE TOWNS. MENDEL - Soft Computing Journal. 2018, 24(1), 165-172.	

Note: List and describe a maximum of five results (in line with the Definitions of Types of Results) that have already been applied in practice, or that will realistically be applied. These are typically results from disciplines in the humanities and social sciences, for which you should briefly describe their anticipated impact.

3.11 Recognition in the international R&D&I community

3.11.1 Participation of the evaluated unit's academic staff on the editorial boards of international scientific journals in the 2014–2018 reporting period

Name, surname and title(s) of the evaluated unit's member of staff	Title, publisher, city(-ies) and country(-ies) of origin of the scientific journal
Michael Valášek, prof. Ing. DrSc.	MULTIBODY SYSTEM DYNAMICS, Springer Nature, CH
Michael Valášek, prof. Ing. DrSc.	VEHICLE SYSTEM DYNAMICS, Taylor & Francis, Abingdon, UK
Matej Daniel, prof. RNDr. Ph.D.	JOURNAL OF MECHANICS, Cambridge University Press, UK
Matej Daniel, prof. RNDr. Ph.D.	SCIENTIFIC REPORTS, Nature Publishing Group, UK
Jan Macek, prof. Ing. DrSc.	JOURNAL OF AUTOMOBILE ENGINEERING SAGE IMechE London UK
František Rieger, prof. Ing. DrSc.	CHEMICAL ENGINEERING AND EQUIPMENT, SIMPRESS, Warsaw, PL
Jan Mádl, prof. Ing. CSc	MECHANIK, Warsaw, PL
Tomáš Vyhlídal, prof. Ing. PhD.	KYBERNETIKA, Nakladatelství Academia, Institute of Information Theory and Automation of the Czech Academy of Sciences, Prague, CZ
Oldřich Vítek, doc. Ing. Ph.D.	MECCA JOURNAL OF MIDDLE EUROPEAN CONSTRUCTION AND DESIGN OF CARS, CTU in Prague, Prague, CZ
Matěj Sulitka, Ing. Ph.D.	MM SCIENCE JOURNAL; MM Publishing; Prague; CZ

Note: List a maximum of ten examples of academic staff's participation on the editorial boards of international scientific journals (e.g. editor, member of the editorial board, etc.).

3.11.2 The most significant invited lectures by the evaluated unit's academic staff at institutions in other countries during the 2014–2018 reporting period

Name, surname and title(s) of the evaluated unit's member of staff	Invited lecture title	Name of the host institution, conference or other event
Sváček Petr, doc. RNDr. PhD.	ON TURBULENT FLOW APPROXIMATION BY FINITE ELEMENT METHOD	Modeling and Simulation of Transport Phenomena (MoST 2014). July 28-31, 2014, Treis-Karden, Germany
Tomáš Vyhlídal, prof. Ing., PhD.	ENERGY AND VENTILATION IN HISTORIC BUILDINGS	The impact of climate change on our cultural heritage. January 13-14 2014, L'Institut National du Patrimoine, Paris, France
Petr Špatenka, prof. RNDr. CSc.	PLASMA TREATMENT OF POWDER AND GRANULATES	29th National Symposium on Plasma Science & Technology (PLASMA 2014). December 8-11, 2014, Mahatma Gandhi University, Kottayam, Kerala, India
Jan Suchánek, prof. Ing. CSc.	WHITE CAST IRONS – CURRENT TRENDS	30th Meeting of the International Tribology Council (IRG-WOEM). 2015 Lisbon, Portugal
Milan Růžička, prof. Ing. CSc.	SMART COMPOSITE HYBRID STRUCTURES	32nd Danubia – Adria Symposium on Advanced in Experimental Mechanics. September 22-25, 2015 Slovakia
Petr Kolář, doc. Ing. Ph.D.	WORKPIECE FIXTURE: IMPORTANT ELEMENT FOR IMPROVING MANUFACTURING PRODUCTIVITY AND ACCURACY OF LOW RIGIDITY COMPONENTS	13th International Conference on High Speed Machining: Progress in High Speed Machining Technology. October 4-5, 2016., Metz, France
Jan Papuga, Ing. Ph.D.	VALIDATION OF FATIGUE PREDICTION MODELS AND OF FATIGUE SOLVERS	Workshop on Structural Integrity and Durability. April 11, 2017, Zagreb, Croatia
Petr Špatenka, prof. RNDr. CSc.	PLASMA TREATMENT OF SEEDS - AN ALTERNATIVE TO CHEMICAL DRESSING.	11th Asian-European Conference on Plasma Surface Engineering. Jeju International Conference Center, September 11-15, 2017, Jeju Island, South Korea
Michal Vojtíšek, doc. M.Sc. Ph.D.	THE AIM FOR REALISTIC ASSESSMENT OF HEALTH EFFECTS OF COMBUSTION	German Chemical Society. Analytica. April 13, 2018, Munich, Germany

	ENGINE EMISSIONS REDUCTION EFFORTS: REAL-WORLD EMISSIONS, UNREGULATED POLLUTANTS, AND EXHAUST TOXICITY	
Matěj Sulitka, Ing. Ph.D.	MACHINE TOOL AND MACHINING PROCESS DIGITAL TWINS FOR INCREASED PRODUCTIVITY OF FINISHING MACHINING	4. Wiener Produktionstechnik Kongress. September 26-27, 2018, IFT TU Vienna, Austria

Note: List a maximum of ten examples.

3.11.3 The most significant lectures by foreign scientists and other guests relevant to the R&D&I field at the evaluated unit during the 2014–2018 reporting period

Name, surname and title(s) of the lecturer	Lecturer's employer at the time of the lecture	Invited lecture title
Nejat Olgac, Prof. D.Eng.Sci.	Department of Mechanical Engineering, University of Connecticut, USA	A JOURNEY ON TIME-DELAYED SYSTEMS: THEORETICAL FUNDAMENTALS MEET PRACTICE. Invited lecture of a visiting professor at FME CTU in Prague, November 12, 2017.
Jorge Angeles, Prof. Ph.D.	Department of Mechanical Engineering, McGill University, Montreal, Canada	KINEMATICS OF POINTING MECHANISMS. Invited lecture of a visiting professor at FME CTU in Prague, February 23, 2015
Zuheir Barsoum, prof.	KTH Royal Institute of Technology, Sweden	DESIGN AND FATIGUE OF WELDMENTS. On: Workshop on Computational Fatigue Analysis. 2017, FME CTU in Prague, 13.,15.-16.11.2017
Michael Zäh, prof.	TU Munich, Germany	TRENDS IN MACHINE TOOL DESIGN AND USE
Tilman Becker, Dr.	DFKI - Deutsches Forschungszentrum für Künstliche Intelligenz, Germany	BIG DATA IN INDUSTRY 4.0 THE SEEDS OF DIGITIZATION
Steffen Ihlenfeldt, prof.	Fraunhofer IWU Dresden, Germany	ENERGY EFFICIENT MACHINE TOOLS AND PRODUCTION SYSTEMS
Jorge Ambrosio, Prof. Ph.D.	Institute of Mechanical Engineering, Instituto Superior Técnico,	MULTIBODY DYNAMICS FORMALISMS FOR MULTIDISCIPLINARY

	Universidade Técnica de Lisboa, Portugal	APPLICATIONS: CURRENT PROBLEMS AND CHALLENGES. 8th ECCOMAS Thematic Conference on Multibody Dynamics, FME CTU in Prague, June 19, 2017
Raffaella Sesana, Dr	Politecnico di Torino, Italy	STRESSES AND THERMAL EFFECTS: ENGINEERING RESEARCH APPLICATIONS
Alec Groysmann, Dr.	Haifa Chemistry, Israel	CORROSION IN SYSTEMS FOR STORAGE AND TRANSPORTATION OF PETROLEUM PRODUCTS AND BIOFUELS
Ning He, prof.	NUAA - Nanjing University of Aeronautics and Astronautics, China	HIGH PERFORMANCE MACHINING OF AEROSPACE PARTS

Note: Relevant solely for the R&D&I field. List a maximum of ten examples.

3.11.4 The most significant elected membership in foreign of professional societies relevant to the R&D&I field at the evaluated unit during the 2014–2018 reporting period

Name, surname and title(s) of the evaluated unit's member of staff	Name of professional society	Type of membership
Michael Valášek, prof. Ing. DrSc.	The International Association for Vehicle System Dynamics (IAVSD)	Secretary general
František Hrdlička, prof. Ing. CSc.	International Energy Agency (IEA) Technology Collaboration Programme (TCP) in the field of Fluidized Bed Conversion (FBC)	Executive committee
Tomáš Vyhlídal, prof. Ing. PhD.	International Federation of Automatic Control (IFAC)	Vice-president for industrial activities - TC 2.2 Linear Control Systems
Miloš Lain, Ing. Ph.D.	Federation of European Heating, Ventilation and Air Conditioning associations (REHVA)	Vice-president, member of the Board of Directors
Jiří Nožička, prof. Ing. CSc.	Von Karman Institute (VKI)	Representative of the Czech Republic on the Scientific Advisory Committee for VKI
Pavel Šafařík, prof. Ing. CSc.	Measuring Techniques in Turbomachinery (MTT)	Member the Senior Scientific and Advisory Committee
Michal Vojtíšek, doc. M.Sc., Ph.D.	European Aerosol Assembly (EAA)	Vice-chairman of the working group on particles from combustion processes

Jan Hošek, doc. Ing, PhD.	European Committee for Standardization (CEN)	Vice-chairman of Technical Committee TC 352 – Nanotechnology
Michael Valášek, prof. Ing. DrSc.	International Federation for the Theory of Mechanisms and Machines (IFToMM)	Representative of the Czech Republic in the Technical Committee for Multibody Dynamics
Tomáš Jirout, prof. Ing. Ph.D.	European Federation of Chemical Engineering (EFCE)	Representative of the Czech Republic in the Working Party on Mixing

Note: List a maximum of ten examples.

SUMMARY LIST OF ADDITIONAL DOCUMENTATION IN MODULE M3

Document Title	Criterion	Location (HTML link)
Social benefit of R&D&I	3.1	https://www.fs.cvut.cz/en/science-research/science-research-at-fme/en-social-benefit-rdi/
Centres of competence	3.2	https://www.fs.cvut.cz/en/science-research/applied-research-projects/en-centres-of-competence/
Revenues from non-public sources	3.4	https://www.fs.cvut.cz/en/science-research/science-research-at-fme/en-revenues-non-public/
Results of applied reserach	3.5	https://www.fs.cvut.cz/en/science-research/applied-research-projects/en-applied-research-results/
Significant applied research results with an impact other than an economic one on society	3.6	https://www.fs.cvut.cz/en/science-research/applied-research-projects/en-results-other-than-economic/
The most significant interactions with the non-academic application / corporate sphere	3.7	https://www.fs.cvut.cz/en/science-research/applied-research-projects/en-results-non-academic/
IP protection and technology transfer at CTU	3.8 and 3.9	http://evaluation-cvut.cz/files/H2020-Technologytransfer.pdf
Awards for R&D&I	3.10	https://www.fs.cvut.cz/en/science-research/en-awards-rdi/
The most significant activities in the popularisation of R&D&I and communication with the public	3.12	https://www.fs.cvut.cz/en/science-research/science-research-at-fme/en-popularisation-rdi/