Projects 2011 - Institute of Materials Science

- **PROJECT OF TECHNOLOGY TRANSFER**

Title of the project	**CENTRE OF EXCELLENCE** Center for Development and Application of Advanced Diagnostic Methods in Processing of Metallic and Non-metallic Materials
Type of the project	OPVaV
Number of the project	ITMS 26220120013 ITMS 26220120048
Main investigator	Jozef Janovec, Professor, DrSc. Ľubomír Čaplovič, Assoc. Professor, PhD.
Time period of the project	2009-2011 2010-2011
Annotation of the project	

The main focus of the project is the establishment of a centre of excellence with emphasis on the development and application of advanced diagnostic methods in processing the metal and non-metal material. This is within the framework of item number 2.1 of the operation program oriented on research and development entitled "Increasing the quality of the workplace and support of excellent research, with a focus on the strategic areas important for next developments of economy and society". Therefore the main aim of the project, which has been approved, is to build a research infrastructure in accordance with the Innovation policy of the second generation, meaning at the regional level and in accordance with priority No1 of the Innovation strategy of the Slovak Republic: "Infrastructure with a high quality and an effective system for innovation development". In this way the proposed centre of excellence will support realization of the strategy of competitiveness in the Slovak Republic into 2010, which is an important transfer into innovation policy of the third generation, with the task of integrating innovations into all policies.

We plan to create a modern dynamic centre of excellence. The centre will focus on analytical methods for applying the most contemporary knowledge on the interaction of electron and laser energies with masses of various types. It will also focus on advanced detection systems with high sensitivity, modern mechanical processes, and observation of electrical and non-electrical variables oriented to the evaluation of specific properties, especially progressive metal and non-metal materials prepared by the most modern technological processes. We expect that the project will help to improve the research infrastructure in the Trnava region, and provide a direct connection to the rest of Slovakia (the Faculty of Materials Science and Technology cooperates with dozens of production companies throughout all of Slovakia and with other education and research institutes). The project will also connect the Faculty to other European and Asian research bodies (we cooperate with POSTECH - Pohang University of Science and Technology, South Korea, IFW and FZD in Dresden, Germany, Bekaert in Zwevegem, Belgium). Finally, the project will improve the quality of education and popularise science and technology among unspecialized people.

The content of the project has the aim of supporting a concentration of the best faculty employees in a monothematic centre based on the application of the most modern experimental processes associated with specific material properties, consistent with the objectives of the Materials study program and the study field of Physical Metallurgy. Activities are focused on the attraction of secondary school students who will potentially study fields of technical materials. The project will also provide access for all interested specialists to modern technical equipment in the centre, as well as the organisation of seminars and summer schools and expansion of materials research and its successful representation in the media.

- **INTERNATIONAL PROJECTS**

Title of the project	Chemical sputtering: Computational modelling of interactions in the carbon containing films exposed to molecular ions and hydrogen
Type of the project	7th Framework Programme of the European Atomic Energy Community
Number of the project	EFDA, No.FU07-CT-2006-00441
Main investigator	Štefan Matejčík, Professor, DrSc., Faculty of matematics, physics and informatics, Comenius University in Bratislava,
Investigator at MTF STU	Miroslav Urban, Professor, DrSc.
Time period of the project	2010-2011
Annotation of the project	

The project aim is to know processes via methods of computer modelling which can be by interaction of products of low-temperature plasma with walls of a reactor by nuclear fusion (plasma – wall interactions). There is the most frequent expectation in construction of fusion reactor walls (particularly in a divertor) that a construction material will be wolfram covered with layer of amorphous hydrocarbon films (a–C:H). One of the project aims is to study the stability and the reactivity of various ions which can occur during interaction of plasma particles with divertor walls, also their capture and release into an area of the reactor. Layers of poisonous BeO are alternative materials which are considered in processes of plasma products interaction. We take into account in our project also other alternatives, e.g. based on compositions of $B_xC_yN_z$, - the content determines if they can create firm layers with properties which are necessary in the material to provide an interaction of the plasma components with reactor walls.

The research team at MTF STU focuses on modelling of the hydrogen interactions with selected $B_xC_yN_z$ thin films. Data are compared with results on the H-interactions with graphene. Methodological development was focused to the treatment of the core correlation and relativistic effects in molecules containing d-shell atoms. Results are being applied to calculations of benchmark data relevant in plasma – wall interactions, namely Be_xW_y species. We were also involved in the development of ab initio techniques for accurate calculations of ionization potentials and electron affinities which are needed in modelling the survival probabilities and recombination energies of the ion in question.

Title of the project	**Investigation of fine structures in metallic materials using TEM**
Type of the project	bilateral
Number of the project	1/IFW-MTF/2009
Main Investigator	Jozef Janovec, Professor, DrSc.
Time period of the project	2008-2011
Annotation of the project	
The scientific cooperation concerns mostly structurally complex materials and thermodynamic calculations. Experts of both partners are encouraged to attend each other. The dominant technique used in the common investigation is TEM. With the intention to improve the investigation of fine metallic structures at the Faculty of Materials Science and Technology of STU, the IFW provided financial resources for purchase of ancillary units for TEM.	

Title of the project	**Preparation and characterisation of lead-free solders**
Type of the project	COST
Number of the project	**COST MP0602**
Main investigator	Jozef Janovec, Professor, DrSc.
Time period of the project	2008-2011
Annotation of the project	
The project is focused on processing and investigation of properties of novel lead-free solders for high-temperature applications. New solders developed in the frame of the project will consist of various combinations of tin, zinc, cobalt, silver, copper and rare earth elements. Thermodynamic and kinetic aspects of soldering will be studied. Phase equilibria and formation of intermetallic	

phases at the solder/substrate interface will also be investigated.

- **NATIONAL PROJECTS**

Title of the project	Properties of lead-free solders and their liquid-state and solid-state interfacial reactions with substrates
Type of the project	VEGA
Number of the project	1/1000/09
Main investigator	Milan Ožvold, Professor, PhD.
Time period of the project	2009-2011
Annotation of the project	
Rare earths are added to improve properties of lead-free solders on base of Sn/Cu/Ag. We added cerium in small amounts (0.1, 0.2 and 0.5 wt%) into eutectic compounds of solders and we compared their properties. Observations showed differences in solders microstructure in dependence on content of Ce. We have studied morphology intermetallics which are formed on the range of fluid solid and copper plate in dependence on time of soldering. The most significant changes were observed for solders SnAg3,5 and SnAg3,5 + 0,5% Ce, by time of soldering 256 seconds. Layer of intermetallics was destroyed in solder with Ce and particular units of the phase Cu6Sn5 did not grow to big shapes and dimensions. Mechanical properties of solders were also measured. Shear strength of solder with eutectic solder SAC357 is significantly higher than one with hypoeutectic solder with low content of silver SACX0307. However relative decline of shear strength of SACX0307 is minimal after ageing 200 hours at temperature of 150°C, while it is significant by eutectic solders.	

Title of the project	Accurate ab-initio calculation of the potential energy hypersurface of ozone for the theoretical molecular spectroscopy
Type of the project	VEGA
Number of the project	1/0648/10

Main investigator	Filip Holka, PhD.
Time period of project	2010-2011
Annotation of project	
The project is focused on ab-initio calculation of global potential energetic hypersurface of basic electronic state of ozone with a sufficient accuracy for next application in theoretical rotation-vibration spectroscopy. To gain this aim we will study into details the convergence of the hypersurface to a limit of complete base, relativistic effects and contribution of internal electrons correlation. One important part of project is the calculation of adiabatic correction and analysis of its influence on a shape of hypersurface. According to this analysis we will design an optimal methodological access which is appropriate for a construction of global energetic hypersurface and we will make a calculation.	

Title of the project	Characterization of structurally complex materials to improve their application possibilities
Type of the project	VEGA
Number of the project	1/0011/10
Main investigator	Jozef Janovec, Professor, DrSc.
Time period of the project	2010-2011
Annotation of the project	
The project is focused on research of complex metal alloys and nanostructure of materials. Alloys of type Al-Mn-TM and Al-Pd-TM in annealed state (TM = transition metal) and Al-CMA composities (CMA = complex metal alloy) are characterised with x-ray diffraction, TEM (HRTEM), DTA, HR SEM, EDX, WDX and EBSD, as well as thermodynamic modelling. Experiments results and theoretical knowledge will help to calculate basic thermodynamic parameters of studied systems and identified phases. Application of progressive experimental methods creates prepositions for innovations in methodology area. Solving of the project will enlarge basic research knowledge with possible transfer into praxis.	

Title of the project	Analysis of irreversible changes in condensed non-crystalline structures.
Type of the project	VEGA
Number of the project	1/0645/10
Main investigator	Stanislav Minárik, Assoc. Professor, PhD.
Time period of the project	2010-2011
Annotation of the project	
The project is focused on a study of causes of permanent (irreversible) changes in selected condensed non-crystallic structures. The main attention will be on processes of polymerisation and photodegradation of plastics, vulcanization of rubber compound as well as irreversible changes in glass structure. Structure modifications are usually typical by creation of free spaces, new parts and phases which can be observed by different way. In case of the mentioned non-crystallic substances the structure modifications cannot be reflected in a visible destroying of structure symmetry. Methods of their identification and evaluation are therefore more complicated than crystallic substances. We will study the examination possibilities of process character via different experimental methods based on IR and UV-VIS spectroscopy, dielectric spectroscopy and thermal analysis. The project aim is a search of correlation possibilities between results of mentioned methods and design of models for description of irreversible processes in non-crystallic structures.	

Title of the project	Accurate calculations and predictions of properties of increasingly complex molecules.
Type of the project	VEGA
Number of the project	1/0520/10
Main investigator	Miroslav Urban, Professor, DrSc.
Time period of the project	2010-2011

Annotation of the project	
The essence of the project is extending the predictive power of Coupled Cluster CCSD(T) calculations of closed-shell and open-shell molecules, applications of CC methods to gradually larger molecules and to provide benchmark data for less demanding but less accurate DFT methods. Enhanced effectiveness of the CCSD(T) method is achieved by new implementation of the idea of reduced virtual orbital space by the OVOS method (Optimized Virtual Orbital Space). We will analyze relativistic effects in the metal – lone-pair ligands for the series of molecules and trends in these interactions. Our model will serve for understanding the processes involved in formation of Self-Assembled Monolayers, suggestions of new materials, as well as in some biologically relevant processes. We also work on calculations of magnetic properties of atoms and molecules including relativistic effects. We work on calculations of dipole moments and polarity of molecules in the ground and excited states having in mind new optoelectronic materials. Accurate calculations of electron affinities of nuclear acid bases are linked with understanding the damage of DNA by low energy electrons.	

Title of the project	Effects of inhomogeneities on functional properties of high-temperature superconducting wires
Type of the project	VEGA
Number of the project	1/0162/11
Main investigator	M. Skarba, PhD.
Time period of the project	2011-2014
Annotation of the project	
Non-metallic superconductors based on mixture of Y, Ba and Cu oxides (YBCO) are well known materials showing superconductive properties at relatively high temperatures. Structural analysis of micrometer superconductive layers on metallic substrate enables to understand the relationship between the parameters of preparation of layer and its properties. During deposition of layer on metallic substrate and during further processing, defects in structure of thin layers of YBCO develop. These defects significantly affect electromagnetic properties of superconductors, especially critical current and ac losses. Information about defects in layers of YBCO, inferred from structural analysis, are useful for decrease imperfections of production of superconductive layers. It is also	

necessary for development of superconductive devices, because they can have significant influence on their working characteristics. Evaluation of structure of thin superconductive layers will be performed mainly with (high-resolution) TEM.

Title of the project	Study of phase equilibria in advanced materials using aimed experiments and computational thermodynamics.
Type of the project	VEGA
Number of the project	1/0339/11
Main investigator	Roman Čička, PhD.
Time period of the project	2011-2013
Annotation of the project	
The aim of the project is to contribute to thermodynamic description, creation and assessment of thermodynamic databases of selected materials systems for Pb-free solders, advanced steels and complex metallic alloys. In experimental part, the chemical and phase compositions of samples in investigated systems will be determined, their thermodynamic properties will be measured and phase transitions will be characterized. These data will be analysed and compared to results of computations of phase equilibria, using CALPHAD method and software Thermocalc. Based on this procedure, the thermodynamic description of phases in investigated systems will be optimized, and values of interaction parameters of components will be refined. These results should be useful for planning further research of new alloys in these systems, aimed to improve the properties of existing materials.	

Title of the project	Promotion of new responsibilities for IT application in materials research and education.
Type of the project	KEGA

Number of the project	327-010STU-4/2010
Main Investigator	Marián Kubliha, Assoc. Professor, PhD.
Time period of the project	2010-2011
Annotation of the project	
The project is focused on an improvement of intellectual skills of graduates of the second and third grades of the university study in area of preparation and management of technical experiment supported with IT technology, especially correct selection, application of communication systems of measurement appliances, technological equipment, sensors, etc. The aim of project is to prepare and implement a subject processed in a specialised laboratory into syllabus. Students can gain new competencies which will increase their ability to be successful at labour market and workplaces which are using a top technology. We expect an increase of research potential and the growth of flexibility of graduates.	

Title of the project	Investigation of special glass technology by physical methods
Type of the project	bilateral, APVV
Number of the project	SK-CZ-0143-09
Main investigator	Vladimír Labaš, Assoc. Professor, PhD.
Time period of the project	2010-2011
Annotation of the project	
The project is focused on a support of cooperation between Slovak and Czech partners in the area of preparation and testing of physical properties of special glasses. The study is focused on the explanation of permanent (irreversible) changes in structure of glasses. Structure modifications are usually typical by creation of free spaces, new particles and phases which can be observed by different ways. In non-crystalline substances the structure modifications cannot be identified by the change of structure symmetry. The process will be characterized by different experimental methods based on IR, UV-VIS, and dielectric spectroscopy and thermal analysis. The aim of the project resides in looking for possible correlations between above methods and proposing of models for description of irreversible processes in non-crystalline structures. Besides the project proposers, also the third partner of France is involved in the project.	

Title of the project	Solidification and properties of novel peritectic TiAl-based alloys
Type of the project	APVV
Number of the project	APVV-0434-10
Main investigator	Juraj Lapin, DrSc., Institute of Materials and Machine Mechanics, Slovak Academy of Sciences in Bratislava
Investigator at MTF STU	Svetozár Demian, PhD.
Time period of the project	2011-2014
Annotation of the project	
Peritectic alloys based on TiAl are excellent candidates for near net shape casting of light-weight structural components for aircraft automotive engines. Industrial gas turbines end new generation of nuclear reactors. To advance the knowledge in emerging casting technology sector of TiAl based alloys, the SOPERIT project aims to investigate microstructure formation and segregation during solidification and solid phase transformation of novel peritectic TiAl based alloys. The attention is directed to understand the effect of solidification parameters and alloying on primary solidification phase, solidification path, phase equilibria, the columnar-to-equiaxed transition (CET), texture formation and nucleation activity of peritectic phase which will open up new opportunities for alloys and process design. The novel peritectic alloys with fine grain structure will be designed and their microstructure and properties (chemical, physical and mechanical) will be characterized. Fine grain structure will be achieved through appropriate alloying affecting nucleation of peritectic phase and solid phase transformations. Unique CET experiments will provide knowledge about mechanisms of nucleation of equiaxed grains, associated segregation and necessary input data for CET modeling. Parallel to these research activities, laboratory near net shape casting technique based on plasma melting in water cooled crystallizer and gravity casting into ceramic moulds will be developed.	

Title of the project	Interactions in bio and nanosystems
Type of the project	APVV
Number of the project	APVV-0059-10

Main investigator	Vladimír Kellö, Professor, DrSc., Faculty of Natural Sciences, Comenius University in Bratislava
Investigator at MTF STU	Miroslav Urban, Professor, DrSc.
Time period of the project	2011-2014
Annotation of the project	
From quantum chemistry of intermolecular interactions to nanoparticles. Obtaining interaction energies for models needed for the "docking and scoring" analysis in drug design, analysis of active sites of the drug and the biomolecule. The model metal – surface interactions, molecular processes at surfaces and cavities. Accuracy assessment of approximate methods of quantum chemistry for larger molecules and molecular clusters employing the relativistic CC data for smaller model molecules.	

Projects 2011 - Institute of Production Technologies

PROJECT OF TECHNOLOGY TRANSFER

Title of the project	**Centre of Excellence for Five-Axis Machining** CE 5-axis machining – experimental base for high-tech research
Type of the project	OPVaV
Number of the project	ITMS 26220120013 ITMS 26220120045
Main investigator	Jozef Peterka, Professor, PhD.
Time period of project	2010-2012

Annotation of the project	
Five-axis machining is one of the main trends in cutting technology used for mould production. The term five-axis machining means cutting machine tools through which the movement carried out moves in five different axes simultaneously. The benefit of five-axis machining is the machine's ability to machine complex shapes in a single set-up and achieve a uniform surface with roughness being cultivated. The Centre will have the opportunity to realize the basic research on 5-axis machining of complex shape parts, including control and measurement and will also be able to monitor the quality of cutting fluids and cutting processes. It will be able to provide for all levels of learning in education together with establishing an experimental base for doctoral researchers from Slovak and foreign universities, and also practitioners. The ambition of the project is to help mould and die manufacturers (developers, designers, technologists, quality control persons, supervisors, young starting engineers and also skilled senior engineers) to mostly find theoretical and practical orientation (guidance) in this difficult cutting process of five-axis machining.	

- **INTERNATIONAL PROJECTS**

Title of the project	Towards common research project in area CA technologies in machining
Type of the project	Cooperation agreement
Number of the project	2/DELCAM-MTF/2008
Main investigator	Jozef Peterka, Professor, PhD.
Time period of the project	2008-2011
Annotation of the project	
The main purpose of the project is to expand the theoretical concept of CAD-CAM-CNC on concept CAD-CAM-CNC-CAQ-CAD and experimentally verify this new concept in the field of manufacturing of free form surfaces and in the field of assembly parts with free form surfaces in the conditions of university.	

Title of the project	Multivariate optimization of the metal spinning processes-research and development (Met-Spin)
Type of the project	6th Framework Programme

Number of the project	MANUNET-2008-SK-001, program ERA-NET
Main investigator	Peter Šugár, Professor, PhD.
Time period of the project	2009-2011
Annotation of the project	
The project of international applied research, solved in cooperation with the research organisation Inpromat, S. Coop., Sondika (Spain) and production company Sandrik 1895, Limited Hodruša-Hámre (Slovakia), is focused on the experimental study of the effect of workpiece geometry, workpiece material and technological parameters of the multi-pass conventional metal spinning process on the stress-strain distribution throughout the part and the influence of these parameters on the part's surface integrity. The results of experimental reasearch, realized on different shapes of spun parts, will be utilize for optimization of metal spinning processes used for production of medical, gastronomy and automotive components from low carbon steel, stainless steel, and aluminium alloys.	

- **NATIONAL PROJECTS**

Title of the project	Special methods for metallurgical bonding of hard-to-weld materials and their application in manufacture of new materials with high technical parameters.
Type of the project	VEGA
Number of the project	1/0842/09
Main investigator	Milan Turňa, Professor, PhD. EWE
Time period of the project	2009-2011
Annotation of the project	
Design, experimental approval, and scientific reasoning of progressive matallurgical bonding of special and combined materials. A selection of special technologies of welding, soldering, etc. or hard-to-weld materials and materials sensitive to degradation in the process of technological processing. An application of new technologies of metallurgical bonding for manufacture of special materials with high technical parameters. Here can be mentioned for example the technologies of solid state welding (explosion, diffusion, MPW:FSW), welding and soldering with concentrated power sources (LB, EB, IB), RS and WS soldering. Engineering of special surfaces. Simulation of technological processes. Diagnosing the structural stability of fabricated joints by thermodynamical calculations with utilisation of	

CALPHAD program and databases for elucidation of mechanisms of joint formation. Design of workplace for explosion welding and building the laboratory for diffusion bonding and soldering with induction heating.

Title of the project	Research of creation and growth of the reaction products in the area of interface solder joints produce by the environmentally suitable alloys in consideration of lifetime and reliability.
Type of the project	VEGA
Number of the project	1/0111/10
Main investigator	Erika Hodúlová, PhD.
Time period of the project	2010-2011
Annotation of the project	
The study of the interface of solder joints made by lead-free solders and the identifying of reaction products which are created in soldering process for low and high temperatures. Acquistion of knowledge on creation and growth of the reaction products in formed lead-free solder joints. Calculation of diffusion coefficient and activation energy in soldering process and activation energy in the diffusion process which brings a complex picture on the mechanism in the process of soldering. It is important to describe the mechanism of solder joint formation with a possibility of influence on joint quality to understand better reactions by soldering. Designed steps of calculation of reaction products rate defines the lifetime and reliability of solder joints.	

Title of the project	The determination of suitable parameters for precision castings production by centrifugal spin casting into silicon moulds.
Type of the project	VEGA
Number of the project	1/0383/10
Main investigator	Matej Beznák, Assoc. Professor, PhD.
Time period of the project	2010-2011

Annotation of the project	
The project subject is a method of centrifugal spin casting of low-melting alloys into silicon moulds with Tekcast method. The priority aim is to determine a technological process and appropriate parameters by production of moulds and to provide the highest possible productivity, exactness and quality of castings.	

Title of the project	The structure and properties enhancement upon production of near-net-shape semi-products using technology of a direct hydrodynamic extrusion of castings
Type of the project	VEGA
Number of the project	1/0099/10
Main investigator	Alexander Čaus, Professor, DrSc.
Time period of the project	2010-2011
Annotation of the project	
The goal of the project is fundamental research on hetero-phases materials - nodular cast iron (NCI) and high-speed steel (HSS) hot mechanically worked by a direct hydrodynamic extrusion (DHE). The structure and properties of NCI and HSS after casting and DHE will be investigated with establishment of relationships between the technological parameters, structural changes and final properties of the materials. Primarily attention will be paid on the study of the effect of deformation on the rate of a structure heterogeneity and anisotropy as well as on physical-mechanical properties of the materials.	

Title of the project	Technological heritability of laser micromachining process and its influence on technological and exploitation properties of material.
Type of the project	VEGA
Number of the project	1/0254/11
Main investigator	Peter Šugár, Professor, PhD.
Time period of the project	2011-2014

Annotation of the project	
The project is aimed at the research of laser micromachining process (laser micromilling and so called laser microstructuring) during machining of metals by solid-state Nd: YAG laser. Two fields of interest are solved in this project. The first is the assignment of laser micromachining influence on the modification of corrosion resistance of corrosion-resistant steels and Ti-alloys. The second area of interest is to define optimal technological conditions of laser microstructuring of sheetmetal forming tools (spinning rollers) with the aim to reach maximal positive influence on the tribological conditions in the forming process.	

Title of the project	Research of weldability of duplex and superduplex stainless steels by concentrated energy sources
Type of the project	VEGA
Number of the project	1/0222/11
Main investigator	Koloman Ulrich, Professor, PhD.
Time period of the project	2011-2014
Annotation of the project	
The project deals with weldability of duplex steels by laser and electron beam welding. Welding of duplex steels by arc welding processes has been previously solved and is currently used in practice. The laser and electron beam welding of duplex steels exhibits problems with regard to proportion of structural components (austenite/ferrite) around 50/50%, resulting to poor corrosion resistance. The right balance of ferrite – austenite phases is important primarily from corrosion aspect, prefering the duplex steels before other stainless steels.	

Title of the project	Joining of surface treated thin steel sheets by modern joining methods
Type of the project	VEGA
Number of the project	1/0203/11

Main investigator	Milan Marônek, Professor, PhD.
Time period of the project	2011-2013
Annotation of the project	
The scientific project deals with joining (welding and adhesive joining) of steel sheets with a different kind of surface treatment. The surface layer significantly influences arc stability of technological process and consequently quality of weld and adhesive joints. As the new joining technologies (laser beam welding, arc welding methods with controlled metal transfer, hybrid welding methods, MIG brazing and adhesive bonding) are gradually being applied in praxis, there is necessary to know fitness of these joining methods to defined surface treatment or to specify range of process parameters leading to quality joint formation.	

Title of the project	Development of lead-free solder for higher application temperatures and research of material solderability of metallic and ceramic materials.
Type of the project	VEGA
Number of the project	1/0211/11
Main investigator	Roman Koleňák, Assoc. Professor, PhD.
Time period of the project	2011-2013
Annotation of the project	
The project is aimed at development of lead-free solder for higher application temperatures. The developed solder is destined for environmentally friendly soldering of metallic and ceramic materials. The developed solder will be used for solderability tests of ceramic and metallic materials with application of flux and without flux by use of power ultrasound. The structural character of solder at diverse soldering conditions will be studied, including the interactions on the soldered metal - solder boundary. The qualitative solderability criteria as wettability, spreadability, capillarity, diffusion and erosion at normal and extreme soldering conditions for the research of application conditions will be determined. Shear strength of joints fabricated with the developed solder in metallic and ceramic materials will be determined. The aging tests and thermal cycling tests of soldered joints will be also performed.	

Title of the project	Investigation of dynamic characteristics of the cutting process in 5 - axis milling in conditions of Centre of Excellence of 5 - axis machining.
Type of the project	VEGA
Number of the project	1/0250/11
Main investigator	Peter Pokorný, Assoc. Professor, PhD.
Time period of the project	2011-2013
Annotation of the project	
The project aims to explore the characteristics of the dynamic cutting process. In this context, the project studies the distribution and effect of cutting forces in the 5 - axis milling. The chatter as well as its origination, effect and ultimately the conditions for its elimination are important dynamic characteristics as well. The project therefore addresses the causes of the chatter in 5 - axis milling and deals with the solutions for milling without the chatter. The suitable choice of CAM milling strategies with regard to the desired shape and quality of a part is also important parameter in the process of 5 - axis milling. The project will therefore also analyse the impact of various 5 – axis milling CAM strategies on dynamic characteristics of the cutting process.	

Title of the project	Study of environmental friendly binder on biological base for moulding sands
Type of the project	VEGA
Number of the project	1/0117/11
Main investigator	Rolad Šuba, PhD.
Time period of the project	2011-2013
Annotation of the project	
Foundry personnel using conventional binders are exposed to numerous known	

carcinogens. The main aim of foundries is to achieve decrease amount of toxic agents in the foundries air with achieving of required mechanical properties of moulds and cores, their good disintegrated properties after moulding and regenerating of sand material. The non-toxic, biodegradable, water soluble binders with rapid thermal breakdown can help to meet and even exceed these requirements.

Title of the project	Research of welding and forming of nitrooxidatively treated steel sheets
Type of the project	APVV
Number of the project	APVV-0057-07
Main investigator	Milan Marônek, Professor, PhD.
Time period of the project	2008-2011
Annotation of the project	
Nitrooxidative layers enhance significantly mechanical and anticorrosive properties of metal sheets. The project deals with the research of nitrooxidative layer making on metal sheets, the research of appropriate welding methods of such treated plates and with the study of forming and corrosive resistance of made weld joints. In the field of welding the basic characteristics of made weld joints will be studied (shape, structure, mechanical properties, weldability) by using the advanced technologies of welding of nitrooxidatively treated sheets.	

Title of the project	The electron beam technological complex for welding, deposition welding and material surfacing
Type of the project	APVV
Number of the project	VMSP-P-0009-09

Main investigator	Koloman Ulrich, Professor, PhD.
Time period of the project	2009-2011
Annotation of the project	
The project subject is research of a technical solution for particular modules and function nodes of a laboratory model of university electron beam technological complex for industrial use. The subject technological complex is suitable for sophisticated industrial applications of high-tech electron technologies in areas of welding, creation of special layers and surface thermal treatment with use of a high-performance source of electrons with specific properties which will enable complex implementation for all mentioned applications. Its technical parameters will provide processing of solders according to the programmed trajectory of solder in a three-dimensional area.	

Projects 2011 - Institute of Production systems and Applied Mechanics

- **PROJECT OF TECHNOLOGY TRANSFER**

Title of the project	**Laboratory of flexible manufacturing systems with robotized manipulation supported by no-drawing production**
Type of the project	OPVaV
Number of the project	ITMS 26220220055
Main investigator	Karol Velíšek, Professor, PhD.
Time period of the project	2010-2012
Annotation of the project	
The aim of the project is to create an elastic production system with robotic regulation which will enable design-free production. The product will be modeled with a PC in an appropriate 3D CAD program, then the regulation program will be generated and it will be started in an elastic production system which will produce a component. It will provide the possibility to produce the necessary components for a concrete product. All produced components will be controlled during production, so the likelihood of failure of finished products will be decreased. This prototype device will help to observe the influence of different production strategies on production costs, time, which is necessary to produce a certain product amount, and other important efficiency parameters of the production. The advantages of design-free production and influence on efficiency of the whole	

process will be observed and presented in pre-production and production phases.

- **INTERNATIONAL PROJECTS**

Title of the project	Development of mechanical engineering (design, technology and production management) as an essential base for progress in the area of small and medium companies' logistics - research, preparation and implementation of joint programs of study
Type of the project	CEEPUS
Number of the project	CIII-PL-0033-07-1112
Main investigator	Karol Velíšek, Professor, PhD.
Time period of the project	2011-2012
Annotation of the project	

Small and medium industrial companies (SMC), according to the opinion of many experts, are the base of developing countries economy. It concerns especially the economy of Central Europe countries, which formerly had non market economy. Development of mentioned industrial enterprises nowadays depends on proper level of mechanical engineering (design, manufacturing engineering, production management) and, in particular, on proper logistics. All of this demands good level of education from proper specialized institutions especially universities. Exchange of ideas, knowledge, results of investigations, students, teachers etc. is the condition sine qua non of high level of research and education in particular university. Thus, existence of the possibility of mentioned exchange is very important from the point of the development of economy.

Technology, one of the most important fields of knowledge of the modern world, determines manufacturing of various machines and mechanical equipment. The development of manufacturing methods is dependent on the intensity of research, the aim of which is obtaining high-quality products in mass production at as low costs as possible. Therefore, the investigations carried out by the majority of European research centers concentrate on basic conventional technologies as well as prospective unconventional manufacturing techniques. Numerically controlled machine tools and also modern computer-aided manufacturing systems are being employed in the analysis and simulation of technological processes. The development of technology enables monitoring of particular stages of the technological process, inspection of the technical conditions of technological machines and devices and control of the production cycle of machine elements. It is also possible to check the manufacturing accuracy (product dimensions, shape, surface quality), evaluate the quality of materials used for the manufacturing of particular machine elements, evaluate and test the final products, and also test the durability and reliability of

machines and devices.

A typical company makes thousands of different parts, in many different batch sizes, using a variety of different manufacturing operations, processes and technologies. It is beyond the capability of the human mind to comprehend and manipulate such vast amount of detailed data. People still need to make decisions regarding how to run a manufacturing company and success in today's competitive environment at home and foreign markets. The pressure on management is continuing to escalate as global competition drives the need for producing a greater variety of high quality products, in smaller sizes and lower costs. These outgoing demands continuously increase the level of complexity present in a manufacturing environment. What is needed, are both the strategy and a tool that can be used to achieve such a purpose.

A global world brings global problems in production engineering. Economic pressure urges manufacturers to make more customized products of high quality, in smaller series, with shorter lead time and of course, without increased costs. Time is becoming one of the most important points of company strategy. Costs are also important. More important is competitive price and the most significant are marketability of manufactured products. Therefore producers look for tools that could increase a competitive advantage of their enterprises.

Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements. Industrial logistics is even more specialized and touches a wide range of topics related to plant supervision, demand planning and production control. Supply chain technology is a critical factor in extracting value. A supply chain strategy is needed to spot the proper supply chain technology. Selecting the right system requires a careful evaluation process that asks the right question and spot proper solutions for logistics and industrial logistics.

Taking into account all the above mentioned aspects of modern manufacturing of machines and technological devices, the following subject of a new research project to be realized within the framework of the CEEPUS program has been proposed.

Title of the project	Applications of Rapid Manufacturing in Biomedical Fields
Type of the project	CEEPUS
Number of the project	CIII-SI-0206-05-1112
Main investigator	Karol Velíšek, Professor, PhD
Time period of the project	2011-2012

Annotation of the project	

Rapid Manufacturing methods are showing a great potential in the field of medical applications. They are at their essence most suitable for individual – custom made parts that are in almost 100% demanded for medical applications. For example, hip implants are nowadays made in series of several modules – sizes. The choice is then made by the surgeon according to the patient's size and without making any mistakes at the decision there are still great chances that the chosen implant won't fit as supposed. The consequences are uneven and therefore rapid wear of an acetabular cup which leads to unplanned revision operations. Data show that 11% of all unplanned revision operations for hip implant's replacements are caused by the misalignment of the implant at the first installation. Using the Reverse Engineering and Rapid Manufacturing techniques a vast majority of these problems can be avoided.

Although a lot of research work has already been done in this field the methods of surgical operations' planning and using the custom made implants haven't been widely adopted by the medical staff. Reasons for that are very diverse but the most common one is a lack of understanding on both, medical as well as engineering side. The proposed network is aimed to overcome these obstacles by joining a small group of medical and engineering institution to develop a common knowledge base that will enable mutual understanding of ever changing research subjects.

The research and educational work in the frame of the network will mostly be aimed to the following research/educational topics:

rocessing of the medical images (from CT and MRI).

rinting Rapid Prototyping (RP) master models for medical applications (planning fitting, training, education).

)esigning and dynamicaly and statically analyzing medical implants

roduction of bio-compatible implants (casting and direct manufacturing).

)eveloping new bio-compatible materials, suitable for RP technologies.

Case studies of using the RP parts for medical purposes.

nalyzing the costs / benefits of using the RP for medical applications.

)isseminating the knowledge and results, etc...

Student and teacher mobility, will offer good possibilities for knowledge exchange and development of new teaching strategies that will address the multidisciplinary aspect of the network's topics – cooperation among medical doctors and engineers. Moreover during the mobility people will learn and benefit from new customs in foreign countries and institutes, develop new friendships and consecutively improve their habits, working principles and knowledge.

Students (under- and post-graduate) will benefit by having a chance to use the large »equipment base« placed over different laboratories of participating universities what will enable them to prepare better final theses.

New contents for interdisciplinary subjects to be taught in the participating institutions will be developed and evaluated during the workshop which will be held between September 15th and 20th in Maribor. The topics will include:

Rapid Manufacturing – medical applications

Quality in medical equipment's production,

Ethics in medicine and engineering,

Reverse engineering of body parts – CT and MRI data conversion and reconstruction of 3D parts, image processing and medical devices,

Design and design optimization for rapid prototyping

Dynamic model construction and simulation for the sizing of implants.

- Implantation process – surgeon's view

Title of the project	Teaching and Research of Environment-oriented Technologies in Manufacturing
Type of the project	CEEPUS
Number of the project	CIII-RO-0013-07-1112
Main investigator	Karol Velíšek, Professor, PhD.
Time period of the project	2011 - 2012
Annotation of the project	

Student mobility - professional achievements - language knowledge - previous or current concerns regarding the aspects of environmental protection and modern technologies in this field
Short Term Student mobility - scientific achievements in the field of environment aspects of manufacturing technologies - language knowledge - publications in the field of network topics - previously contacts between partners
Teacher mobility - professional and teaching achievements in the topics of network; - language knowledge - leading of diploma works and philosophical degrees in this field - previously contacts between colleagues from partner's departments - participation at scientific conferences, workshops organized by partners - comon specific activities with PhD students.
The coordinator of the network and the representatives of the partner institutions establish a working procedure at the beginning of the academic year. The working procedure contains the objectives of the activities, the responsibilities of each partner and deadlines. The coordinator of the network checks the fulfillment of each activity according to the previously elaborated working

procedure. At the end of the academic year, the coordinator writes a final report on the basis of the partial reports submitted by the participants and summaries received from the teachers and students which were involved in this program. Also we intend to built one particulary web-page of the network in which we planed to present the main aspects of activities from network. Publishing the main results at Scientific Conferences organised by partners.

Title of the project	Implementation and utilization of e-learning systems in study area of production engineering in Central European Region
Type of the project	CEEPUS
Number of the project	CIII-RO-0202-05-1112
Main investigator	Karol Velíšek, Professor, PhD.
Time period of the project	2011 - 2012
Annotation of the project	

Access to lifelong learning can be solved using the e-learning systems. Information and communication technologies (ICT), properly used, contribute to the quality of education and training and to Europe's move to a knowledge-based society.

The universities have to know to respond on global problems and to be prepared to educate the specialist. Many of the new methods used in production engineering and in CA systems and technologies as rapid machining, virtual prototyping, CAD/CAM/CAE/CMMS are based on "e" (electronic) activities because reduce the time (time is becoming rapidly the most strategic topic of companies) and increase the quality of products without increasing the costs.

E-learning comprises all forms of electronically supported learning and teaching. E-learning applications and processes include Web-based learning, computer-based learning, virtual classroom opportunities and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio.

The main action lines of the e-learning systems in study area of production engineering are based on

- -Information and Communication Technologies (ICT):
- -Digital literacy as e-books, e-papers, e-courses, etc.
- -The teaching process must be based on e-presentations (slide-shows, papershow system, etc.).
- -Development of virtual laboratories especially in case of equipments with large dimensions.
- -Development of simulations for improves the functions parameters.
- -Using the virtual tests for find the possible errors in design.
- -Using the simulations for improve the maintenance and reliability of machines and equipments.
- -Implementation of virtual laboratories specific for each University and realization of virtual laboratory network between Universities
- -Implementation of modern communications technologies, especially for the case of lifelong learning, between the students and teaching staff of universities
- -Simulations of industrial logistics activities.

All activities concerning the “e” (electronic) are keys for solving of global problems of producers and global problems of universities. It is necessary to solve the legislative frame of common interest and accord the national legislative frame with the European legislative frame.

Joint programs give a good platform for an increase of collaborated universities and using of e-learning systems can increase the efficiency. Therefore the subject of new CEEPUS III network is titled *“Implementation and utilization of e-learning systems in study area of production engineering in central european region”*

The principal motive is elaboration and implementation of Joint programs in study area of Production engineering based on collaboration agreements between partners. The proposed network wants to develop the existent collaborations agreements between partners (North University of Baia Mare College of Nyíregyháza, Poznan University of Technology, Technical University of Cluj Napoca, St. Istvan University from Godollo, University Politehnica Bucuresti, University of Žilina Technical University in Košice) and to put the bases for the next agreements. All presented activities (organizing of conferences and workshops, seminaries for students and PhD students, support for elaboration and finishing of PhD thesis, excursion) will be hence forward supported and there will be effort to increase their level in framework of Joint programs.

The e-learning initiative of the European Commission seeks to mobilise the educational and cultural communities, as well as the economic and social players in Europe, in order to speed up changes in the education and training systems for Europe's move to a knowledge-based society.

Title of the project	Technical Characteristics Researching of Modern Products in Machine Industry (Machine Design, Fluid Technics and Calculations) with the Purpose of Improvement Their Market Characteristics and Better Placement on the Market
Type of the project	CEEPUS
Number of the project	CIII-RS-0304-04-1112
Main investigator	Karol Velíšek, Professor, PhD.
Time period of the project	2011 – 2012
Annotation of the project	
Market globalization has had an effect on product assortment extension on the market, which brought many benefits to the consumers. They are enabled to buy products of different quality, price, design and terms of delivery. Major manufacturers have received globalization with a great pleasure, because globalization enabled them expansion of the market and all the preferences that follow with this. Small and medium manufacturers are the most affected with globalization, because of presence of concurrents, so they can’t place their products anymore in such amount like before, or even they can’t do it at all. Due to globalization, they had to reduce their assortment and intensively to develop existent products, so they could become more competitive. All who didn’t succeed this, had to change their production program, or simply to close their factories.	

The global world brings global problems in industrial production. Economic pressure urges producers to make more customized products of high quality, in smaller series, with shorter lead time and of course, without increased costs. Time is becoming one of the most important point of the companies strategy. Costs are also important. More important is competitive price and the most significant are marketability of manufactured products. Therefore producers look for different ways (new design, modern tools, etc.) to increase a competitive advantage of their products.

In most cases, leading competitors bought all perspective companies (their potential competitors), so they continued to produce, but, after this, different products.

So, if small and medium manufacturers want to stay on a globalized market, they intensively and incessantly must develop their products, apply new technologies and nourish aggressive marketing, because it is the only way to subsist at the market.

When some product is being analysed, we can discuss its aesthetic characteristics (shape, color, style), its technical characteristics (dimensions, mass), its service characteristics (capacity, energy consuption), functional characteristics (principle of functioning), and design (construction and performance way). However, when the product occurs on the market, its market characteristics become very important. It is necessary that manufacturers always have to develop market characteristics of their products in order to encourage potential customers to choose their products. The final selection of the products and producers by consumers is dependent on the market characteristics of the product, ability of marketers and retailers or buyers and sellers to point out those characteristics and use them in forming the prices and other sales aid activities (delayed payments, credit, exchange etc.)

The market characteristics are the following: nature and complexity of the product, specific characteristics, variety of the palette of products, quality, design, price, product brand, image of the product, packaging, production date, distinctiveness and protection of the product, sales brochures and catalogues, marketing support, availability of the product, customer service, timing of product delivery, warranty terms, technical support, service support, etc.

The majority of market characteristics are influenced by the producers themselves, and they have the biggest responsibility for the sales of their own products. However, the role of the retailers is also important, which leads to the conclusion that the sales problem should be tackled with a complex approach, with the full cooperation of all involved parties. This is especially relevant today, when increase of the sales of domestic products is a priority and all the relevant information regarding the quality of the products should be disclosed. Also, it is very important to secure availability of the domestic products supply, keep the public informed of where those products are sold, ensure that they are recognizable in retail outlets, label separately that they are produced domestically, outline the reasons why consumers should choose them over competition, train the sales staff in detail about the advantages of the domestic products and encourage them to present that to the consumers. All of these factors can have a significant influence on the consumers, and in addition to affordable pricing, credit financing, attractive design and good image, they can play a determining role in decision-making regarding the purchase of domestic products by the consumers. It is also important to accentuate high impact of the image of the product, which is dependent on the image of the producer, image of the current customer base, product design image, packaging image, image of the visual graphics displayed on the product and packaging, image and

perception of pricing, image of retail outlets, image of the promotional activities, image of the after sales support services etc.

Technical characteristics depend on the nature of the product so that with sports equipment importance is in design, comfort, recognition and price; with household appliances importance is in design, ease of handling, low weight, easy maintenance, low noise and price; with transport vehicles, design, comfort, fuel usage, low emissions and environmental issues; with working machinery, capacity, precision, and the degree of automation; with generators and energy converters, power, and effective utilization which show the degree of perfection of converting the energy. Technical characteristics can significantly improve the market characteristics of the product and such can influence the better placement on the market.

Taking into account all the above mentioned aspects of technical and market characteristics of the products, the following subject of a new research project to be realized within the framework of the CEEPUS program has been proposed:

Technical Characteristics Researching of Modern Products in Machine Industry (Machine Design, Fluid Technics and Calculations) with the Purpose of Improvement Their Market Characteristics and Better Placement on the Market

The necessity of the network cooperation

The universities included in this network have been collaborating with each other, though not always formally, for a number of years. Several partners have experience and achievements in the CEEPUS projects cooperation. CEEPUS project represents a very useful formal way for cooperation between the partner institutions. The network assures an efficient possibility for students and teachers mobility, that contribute to mutual acquaintance and to valuable educational and research programs development. Exchange of knowledge and experience is very important for each university teacher and student. Not only acquisition of necessary information has big significance but also dissemination is characteristic for universities and other scientific institutions. Another important possibility is the possibility to create joint programs of study, common evaluation of diploma and PhD works.

Title of the project	Development of manufacturing technologies – new strategies and new challenges in education and research
Type of the project	CEEPUS
Number of the project	CIII-BG-0614-01-1112
Main investigator	Peter Košťál, Assoc. Professor, PhD.
Time period of the project	2011 - 2012
Annotation of the project	

Time and digital technology are the most strategic topics for companies in order to survive. Nowadays manufacturing is characterized by intensive use of computers, communication and information technologies.

New methods of manufacturing technology, computer aided systems and information technologies, virtual machining are indeed strong tools for solving the global problems. The manufacturers look for tools to improve their enterprise competitiveness - to produce more products with less material, less energy and less waste. Additionally, they have to take environmental considerations. This means that the choice of materials and the designed solution cannot be done on purely technical and economical criteria, but must also take recycling, pollution and disassembly concerns into account.

This new project will allow our future engineers to work more project oriented, and to combine state of the art know-how with theoretical insight. Thus, this project will meet future industrial needs for highly trained professionals in the manufacturing industry. It will be directly linked to technology and innovation across the universities in Central and Eastern Europe.

Title of the project	Development of models for numerical simulation and optimisation of unconventional material processing in semi-solid state
Type of the project	APVV
Number of the project	SK-CZ-0180-09
Main investigator	Mária Behúlová, Assoc. Professor, PhD.
Time period of the project	2010-2011
Annotation of the project	
The project is focused on the design, analysis and optimization of material processing in semi-solid state with the aim to obtain final products with very fine microstructures and unique material properties. The main aim of the project covers the attainment of experimental, model and simulation support for the design and optimization of forming processes in semi-solid state and their application for the production of small products from high-alloyed tool steels. The solution methodology will be based on the close coupling of up-to-date experimental and diagnostic methods with the advanced methods of mathematic modeling and numerical simulation of material behavior in semi-solid state. For this purpose, a unique technical, laboratory and software equipment of both workplaces will be exploited.	

- **NATIONAL PROJECTS**

Title of the project	Experimental and simulation methods of dynamic analysis of mechatronic subsystems of technological equipments
Type of the project	VEGA
Number of the project	1/0256/09
Main investigator	Milan Naď, Assoc. Professor, PhD.
Time period of the project	2009-2011
Annotation of the project	
A mechatronical approach to modelling, analysis, and design of effective modern technological equipment is forced by the inevitable mutual integration of mechanical, electrical, electronic and control subsystems, as well as by their integration with the terminal technological process. This type of integration calls for development of methods for analysis and synthesis of energetic and information flow among subsystems with regard to efficient satisfaction of the functional objectives of the complete technological system.	

Title of the project	Intelligent assembly cell
Type of the project	VEGA
Number of the project	1/0206/09
Main investigator	Karol Velíšek, Prof. h. c. Professor, PhD.
Time period of the project	2009-2012
Annotation of the project	
A flexible and intelligent assembly cell concept includes a new solution for how to create structures of assembly systems. No external industrial robot is used for manipulation or for assembly. Intelligent behaviour of the system will rely on monitoring of important parameters of the system and there will also be monitored information about the system's interaction with its surroundings. Surrounding interaction information will be taken with many advantages, such as bringing flexible reactions of the system to manufacturing changes, building up the area of saving, lowering building costs, and higher use effects of the whole device.	

Title of the project	Clamping fixtures in intelligent production systems
Type of the project	VEGA

Number of the project	1/0163/10
Main investigator	Peter Košťál, Assoc. Professor, PhD.
Time period of the project	2010-2011
Annotation of the project	
A new generation of clamping fixtures presents systems of clamping fixtures that are applicable for use in intelligent production systems. A distinctive effect of incidental time reduction is possible to achieve by automated clamping and manipulating operations or by a defined degree of clamping fixture intelligence. It is also possible to achieve a relevant increase of production process effectiveness in the present increase of process quality by use of fixture clamping.	

Title of the project	Analysis of non-equilibrium thermal, metallurgical and stress-strain processes in production technologies involving rapid cooling and solidification of metallic materials.
Type of the project	VEGA
Number of the project	1/1041/11
Main investigator	Mária Behúlová, Assoc. Professor, PhD.
Time period of the project	2011-2013
Annotation of the project	
Rapid cooling and solidification of materials in non-equilibrium conditions is used in several advanced technologies of production and processing of metallic materials. The research in the framework of the project will be focused on experimental investigation, numerical simulation and analysis of non-equilibrium thermal, metallurgical and stress-strain processes in technologies of preparation of rapidly solidified powders using inert gas atomization of melt, material forming in semi-solid state and also the laser welding and surface heat treatment. The main aim of the project is identification of common characteristics, phenomena and non-equilibrium processes leading to the development of refined microstructures in the conditions of rapid cooling and solidification of materials. In the theoretical field, the project should contribute to the explanation of physical and metallurgical reasons and mechanisms of meta-stable structures development in the high-alloyed materials on the base of iron and aluminium.	

Title of the project	Numerical,symbolic and experimental analysis of nonconservative mechanical systems

Type of the project	VEGA
Number of the project	1/0389/11
Main investigator	Tibor Nánási, PhD.
Time period of the project	2011-2013
Annotation of the project	
Undesired vibration and excessive noise is persistently accompanying even the operation of the most advanced technological systems. Proposed project is oriented on development of analytical, numerical and experimental methods of analysis of complex mechanical systems with non-conservative couplings. The aim is to create suitable models of non-conservative systems and to solve corresponding vibro-acoustical problems by those methods, which in take into full account the non-self-adjoining nature of the boundary problems. Such approach may be found in contradiction with common practice when the non-conservative problems are, using artificial assumptions, transformed to a form which can be approached by conservative methods. The project involves also design and building of equipment for measurement of damping as function of frequency and temperature as well as of equipment allowing to non-conservative loading of the structure under consideration.	

Title of the project	Application of innovative layers and coatings for reconstruction of tribologicaly loaded surfaces.
Type of the project	VEGA
Number of the project	1/0390/11
Main Investigator	Eva Labašová, PhD.
Time period of the project	2011-2013
Annotation of the project	
The operation of technical systems causes natural variation of contacting surfaces of their interacting components. Changes are due to the wear of surfaces and in many cases, tribological degradation of the loaded surface occurs in consequence of unstable operating processes. Changes in geometry of tribological surfaces (TS) generate undesired power transfers, which cause continuing degradation of TS element, possibly leading to damage. Early diagnosis of the incorrect function of TS and its post-reconstruction by innovative layers causes renewal of the correct tribological function of the surface, prolonged element life time and restores the correct operational	

state of the technical system. The aim of the project is to analyze the properties of tribological layers in terms of material and geometrical parameters. Stress-strain states of loaded TS with innovative layers will be examined by methods of computational mechanics. The results of computer analysis, of the wear process of lifetime will be verified experimentally.

Title of the project	Laboratory of Production System program Controll
Type of the project	KEGA
Number of the project	3/7131/09
Main investigator	Peter Košťál, Assoc. Professor, PhD.
Time period of the project	2009-2011
Annotation of the project	
The Laboratory of Production Systems Program Control will be used for automated program control learning. In this laboratory real industrial parts for automation (PLC, sensors, stepper motors, servo motors and others) will be used. Students in this laboratory will learn about automation in the field of flexible production, and they will get new experiences about automated production works. They will get key competencies needed by industrial praxis from graduates of technical universities. In the frame of this project new studying materials about automated program control systems will be created.	

Projects 2011 - Institute of Applied Informatics, Automation and Mathematics

- **INTERNATIONAL PROJECTS**

Title of Project	Improving the gender diversity management in materials research institutions (DIVERSITY)
Type of the project	7th Framework Programme
Number of the project	230253
Main investigator	Oliver Moravčík, Professor, PhD.
Time period of the project	2009-2011
Annotation of the project	

The DIVERSITY project is an international consortium of 14 partners from 11 European countries: Germany, Austria, Belgium, France, Spain, Italy, Sweden, Slovenia, UK, Slovakia, and Greece. Project "DIVERSITY" is a 36 month project funded by the European Union within the 7th Framework Programme.

- **NATIONAL PROJECTS**

Title of the project	Data mining usage in manufacturing systems control
Type of the project	VEGA
Number of the project	1/0214/11
Main investigator	Pavel Važan, Assoc. Prof. PhD.
Time period of the project	2011-2013
Annotation of the project	
The project is oriented on the use of data mining techniques and gaining knowledge of manufacturing systems through them. They will be used in the management of these systems. The simulation models of manufacturing systems will be developed for obtaining the necessary data about controlled production systems. Different control strategies will be implemented in these simulation models. We will develop a way of storing data obtained from the simulation models in the data warehouse (it will include thousands of records). A data mining model using specific methods and selected techniques for a defined particular problem of production system management will be created. We achieve the new knowledge about the production management system by this way and also learn how to achieve these goals by changing the production parameters of a particular management strategy. Acquired knowledge will be tested on a simulation model of the production system. An important benefit of the project will be proposal of the methodology. This methodology is focused on data mining from the databases that store operational data during the manufacturing process.	

Title of project	Content Integration and Design of a University Textbook for "Specialized Robotic Systems" in Print and Interactive Modules for University of Technology in Zvolen, Trenčín University and Slovak University of Technology in Bratislava.
Type of project	KEGA
Number of project	3/7285/09

Main investigator	Pavol Božek, Assoc. Prof. PhD.
Time period of project	2009-2011
Annotation of project	
The project aims to develop an undergraduate textbook writing and interactive multimedia form. Movies made on robo-technologic specialist departments will complement each chapter and the aforementioned written university textbooks	

Title of project	The teaching model of mathematics with the use of new technologies.
Type of project	KEGA
Number of project	021STU-4/2011
Main investigator	Mária Mišútová, Assoc. Prof. PhD.
Time period of project	2011-2012
Annotation of project	
The research project deals with the creation of ICT teaching model of mathematical courses. This teaching model was designed with the aim to increase flexibility and quality of teaching mathematical subjects at the Faculty of Materials Science and Technology in Trnava.	

Projects 2011 – Institute of Industrial Engineering, Management and Quality

- **INTERNATIONAL PROJECTS**

Title of the project	AUTOCLUSTERS
Type of the project	South East Europe Programme
Number of the project	
Investigators	Dagmar Cagáňová, Assoc. Professor, Miloš Čambál, Assoc. Professor, Jana Šujanová, Assoc.

	Professor, PhD., Zdenka Gyurák Bábeľová, MSc. PhD., Zuzana Lenhardtová, MSc., PhD., Miriam Ševčíková, MSc., PhD., Petra Marková, MSc., PhD., Martina Jakábová, MSc., PhD.
Time period of the project	1.4.2009 – 31.3.2012
Annotation of the project	
The Project brings together Universities, R&D institutions, SME support facilities from EU-15, NMS as well as IPA to prepare and create the first automotive network in South East Europe. The second level clustering activities proposed by the project are strictly oriented on the activities, which are improving the innovation capacities in the region and improve technology and know-how transfer - improving the innovation circle. The project in the first stage analyses the cluster's development and best practices across the regions as well as creating the connection with other existing European activities in the automotive clustering. The project focuses highly towards producing concrete results and addresses the main challenges that are particularly specific for SEE region, particularly the same across the whole EU territory. The project is built up on experience from previous activities in Automotive industry (NEAC, Automotive Clusters, Belcar, TCAS, I-CAR-O) and in line with EU policies, especially in clustering and automotive industry. The framework's project aims to: - Create the first sustainable network in automotive industry in SEE region with specific focus on innovation activities - Create partnerships which consist of institutions from New Member States, non-EU members as well as well experienced institutions from EU-15 - Invite in the network not just clusters and other SME supporting facilities but directly also R&D institutions and universities - Improve innovative capability by realizing studies of innovation capacities, exhibition in universities and dissemination outputs of our activities, exchange studies and networking activities - Prove the concept by realizing the project samples and by generating of the proposals to FP7	

Title of the project	**DIVERSITY. Improving the Gender Diversity of Management in Materials Research Institutions**
Type of the project	7FP
Number of the project	
Investigators	Oliver Moravčík, Prof. Dr., Dagmar Cagáňová, assoc. prof., František Horňák, assoc. prof., Peter Halada, MSc., PhD., Jana Štefánková, MSc.
Time period of the project	Jan. 2009 – Dec. 2011
Annotation of the project	
DIVERSITY is a support action - type project funded by the European Commission within the 7th Framework Programme for research and technological development and addresses to the Capacities	

programme, part 5 Science in Society, activity 5.2.1. Gender and Research, thematic area 5.2.1.1. Strengthening the role of women in scientific research. The project has started on the 1st of January 2009 and will last 36 months.

This consortium aims to tackle the problem of under-representation of women in decision-making by fostering the change in institutional culture and changing the attitudes with regard to gender diversity in materials research organisations. In this way a more stimulating research environment in the spirit of the European Charter for Researchers and the Code of Conduct for their Recruitment will be achieved.

The central goal of the project is to identify the effective methods, policies and mechanisms in order to support women scientists in relation to their access to decision-making positions in the sphere of materials research, which traditionally is a male-dominated scientific field. Commitment to the promotion of women to the highest level of research is anchored at the topmost political and institutional level in DIVERSITY project.

Gender equality in science is not simply a question of fairness. To strengthen research...total human capital must be utilised.

- **NATIONAL PROJECTS**

Title of the project	Project Managemet Processes Maturity Control as a Tool for the improvement of the mechanical engineering enterprises competitiveness.
Type of the project	VEGA
Number of the project	1/0491/09
Main investigator	Jana Šujanová, Assoc. Professor, PhD.
Time period of the project	2009-2011
Annotation of the project	
Management is one of the most dynamically developing business disciplines. One of the outputs of this development is the growing number of international standards, along with methodologies and project management tools. Business practice has to face the problem of the effective implementation of those standards in their internal project management processes and more in the project quality control that should lead to the achievement of a higher project maturity level. A higher project management maturity level in business practice means achievement of the project goals with less resources, lower costs and shorter time. All this could not be accomplished without the proper tools. Therefore the objective of this project is to prepare a widely applicable reference manual and tool for the project management processes maturity control in Slovak mechanical engineering enterprises, with the aim of increasing their effectiveness and sustainable competitiveness.	

Title of the project	Creation of teaching material of the secondary school subject "security technology" with using of interactivity MM of education software and e-learning
Type of the project	KEGA
Number of the project	144-039STU-4/2010
Main investigator	Rudolf Rybanský, Assoc. Professor, PhD.
Time period of the project	2010-2011
Annotation of the project	
The project is focused on creation of interactive multimedia teaching applications to increase the level of the pedagogical process with necessary video sequences, pictures and other multimedia aspects of the subject Security technology. It is for students of the secondary schools with an identical specialisation. One more intensive, more efficient and rational perception of information in specific subjects enables presentation of multimedia in many forms (text, schemes, photographs, speech, animation, video, tests). Today it is very important to find the main idea and aim of a studied subject in a flow of information. Interactive multimedia and hypertext where students can enter are the correct tools to support studied information, easy search, testing and easy orientation in them.	

Title of the project	Concept of the HCS model 3E vs. concept of the Corporate Social Responsibility (CSR)
Type of the project	APVV
Number of the project	LPP-0384-09
Main investigator	Peter Sakál, Professor, PhD.
Time period of the project	2009-2012
Annotation of the project	
The aim of the mentioned project is to enlarge the results of the research project Number	

019/2001: "Transforming Industry in Slovakia through Participatory Ergonomics" (financially supported by a common Slovak-American fund for research cooperation) and also of the project KEGA MŠ SR Number 3-3111-05. In these days the research continues in cooperation with the company CHIRANA PROGRESS, s.r.o. Piešťany in the area of permanent development (TUR) and Corporate Social Responsibility (CSR). The aim of this research is to contribute to the vision implementation of Agenda 21 and the Lisbon strategy, in particular the strategy for the parts TUR in conditions of research and pedagogical processes on the workplaces of MTF STU Trnava.

Projects 2011 – Institute of Safety and Environmental Engineering

PROJECT OF TECHNOLOGY TRANSFER

Title of the project	**Hybrid power supply for technical consultancy laboratory for the use and promotion of renewable sources and energy**
Type of the project	OPVaV
Number of the project	ITMS 26220220056
Main Investigator	Doc. Ing. Bohunil Taraba, CSc.
Time period of the project	2009-2012
Annotation of the project	
Prototype of a hybrid source-based RES construction (hydro-potential, solar, biogas and bioethanol) for long term testing and promotion. Through the proposed interventions the prestige of research will be increased, which will also lead to increased interest in the quest for talent and higher employment in this field. The benefit will be new creative ideas and flexible responses to the needs of small enterprises and their closer cooperation. The resulting effect will be more competitive research teams within the national research, more interest in small and medium enterprises to conduct research focused on innovation in public research institutions, universities and other research centers. Slovak research teams will also compete at the international level, bringing the Slovak research development greater cooperation with the international environment and higher success of Slovak applicants in the 7th Framework Program of EU and other EU initiatives.	

- **INTERNATIONAL PROJECTS**
- **NATIONAL PROJECTS**

Title of the project	**The exploitation of advanced oxidation processes in removal of organic pollutants from machine industry wastewaters by the use of wastes from production and treatment of metals as catalysts.**
Type of the project	**VEGA**
Number of the project	1/0352/09
Main Investigator	Maroš Soldán, Assoc. Prof. PhD.
Time period of the project	2009-2011
Annotation of the project	
The research focuses on innovation of degradation processes of organic pollutants in wastewaters by the use of oxidation in the presence of catalysts. Some wastes from treatment and production of metals will be used,	

such as red mud, black nickel mud, etc. The new possibilities for reduction of environmental impact from cutting and surface processes will be tested.

Title of the project	**Materials in fire protection - college textbook and recent educational tools in the field of protection to the persons and property and related fields.**
Type of the project	**KEGA**
Number of the project	015-002TUZVO-4/2010
Main Investigator	Karol Balog, Professor, PhD.
Time period of the project	2010 - 2011
Annotation of the project	
Creation of modern textbook, printed and electronic teaching aids for education at all three levels in the protection of persons and property and related fields in particular to support the external forms of education with on-line access for workers in the field of fire protection and security. The involvement of recognized experts from two universities, test, and practice fire companies to update and bringing new knowledge about the structural and functional materials. Possibility of verifying the basic knowledge and methods of evaluation, certification of materials. Integration of product information, the knowledge of the practice, the results of laboratory tests and safe handling, transport and processing in terms of fire protection.	

Title of the project	**Natural phenomenon for small and big issues in experiments**.
Type of the project	**APVV**
Number of the project	LPP-0171-07
Main investigator	Anna Michalíková, MSc. Eng.
Time period of the project	2008 - 2011
Annotation of the project	
A communication portal will be created that will be oriented to the pilot ideas: environmental education and health, physics in common life, astronomy, alternative sources of energy, wastes and recycling ... (Realized after consultations - investigation - with teacher from basic and secondary schools). It will facilitate communication with the public and students of basic and secondary schools. E-materials and recorded experiments will be published on the created web page (it could be used in pedagogical process, also in preparation of talented students to some competition). During the preparation of materials, from teacher´s requirements for experiments will be determined which are not able to be realized due to dangerous chemicals, absence of tools and instruments).	