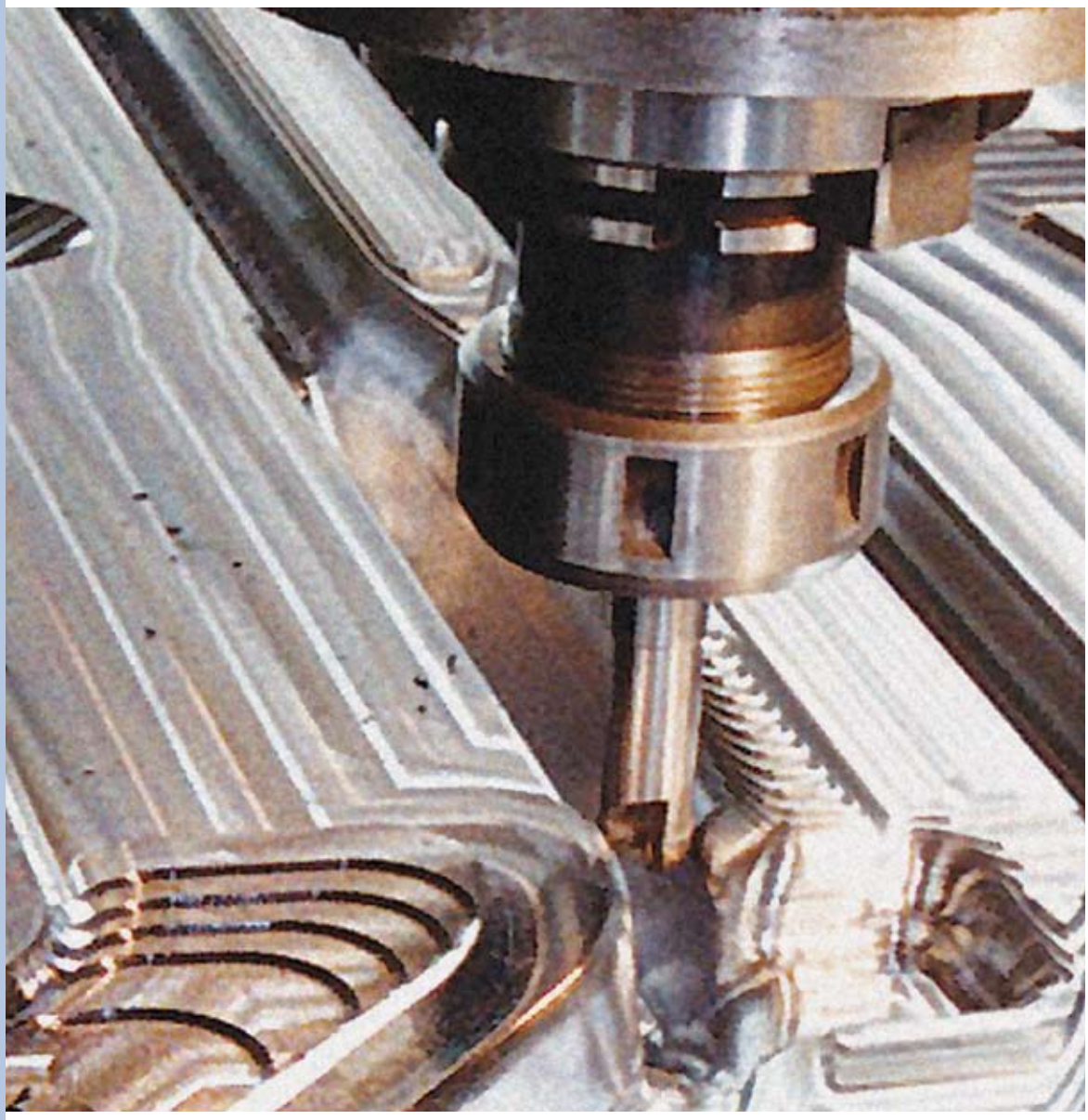
JRET

REGIONAL UNIVERSITY
KNOWLEDGE CENTER
FOR VEHICLE INDUSTRY

SZÉCHENYI ISTVÁN UNIVERSITY GYŐR

# Annual Report 2007



Péter Pázmány program

**Established by the support of the National Office for Research and Technology.**

NKTH
Nemzeti Kutatási és Technológiai Hivatal

## OUR PARTNERS:

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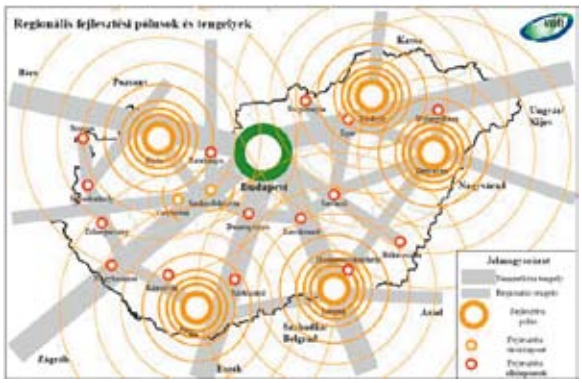
# Mission statement of the Regional University Knowledge Center for Vehicle Industry

The mission of the Knowledge Center is to act as a scientific and technological innovation center in the field of vehicle industry in cooperation with the economic sector, to perform outstanding research and operate a development network in the region and thereby to enhance the country's competitiveness and to support the region's economic development.

The Knowledge Center offers a research infrastructure and human resources that are available for every enterprise in order to elaborate and implement new technologies as well as to create competitive automotive products.

In the long-term the organization intends to operate as a center of excellence, which is one of the determinant factors in automotive innovations in the Austrian-Slovak-Hungarian border region.



# Széchenyi István University's mission statement

Széchenyi István University wishes to take on an initiative and innovative role in the great challenge of the 21st century, in the deployment process of the knowledge society. Their establishment was primarily based on the future social and economic needs of the development in Upper Transdanubia. Their greatest ambition is to become a knowledge center that serves its region – and thereby the country – with its vast educational, research and development resources to offer. They assume an initiative role in enriching the cultural and scientific life in Győr and its surroundings.

In the interest of their mission:

With the results of their scientific activities and with their experiences acquired through their application they contribute to fact that the students acquire the most modern knowledge that is also applicable in practice and thereby building a strong base for their professional careers.

By creating the efficient conditions for life-long learning, they offer numerous opportunities for continuing education in order to maintain the competitiveness of the knowledge already acquired.

Through their doctoral schools and other scientific and professional workshops, they systematically improve their lecturers' and researchers' scientific and professional preparedness, respectively. They make sure that the community of lecturers and researchers are kept up-to-date and its structure is adapted to the ever-changing tasks.

By expanding their international relations and through their activities, they integrate into the domestic and European scientific community and among the institutions of higher education.

They maintain constantly expanding, intensive relations with the economic sector. With the scientific activity of the professional workshops, they support the development of manufacturing or service activities and help the reinforcement of the industrial competitiveness.

They actively participate in acquiring the resources necessary for their activities by offering research services and by utilizing international tenders and other opportunities.

Based on their quality development program, they constantly make sure that there is an effectively and economically operating organization serving the students' and partners' needs to a maximum extent.

# Overall aims (strategy)

The Regional University Knowledge Center for Vehicle Industry serves the research and development needs of the automotive industry belonging to the economic catchment area of Győr. This concentration has a nationally outstanding role as 57% of those employed in the domestic automotive industry work in the Middle and West-Transdanubian region. Within this, the activity of Győr-Moson-Sopron County in the vehicle industry is 4.7-fold compared to the national average.

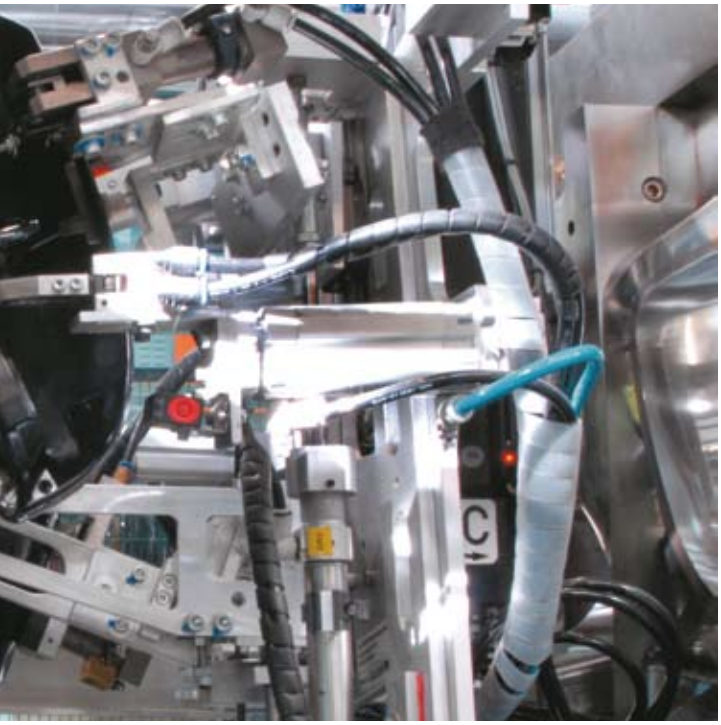
Internationally the Central European car manufacturers count on producing 4-5 million vehicles and 3 million engines by 2010. At the same time there is expected to be a strategic reorganization in the division of labor between the end product manufacturers and the suppliers, for the benefit of the latter, which will primarily be manifested in the fact that while vehicle sales will grow by 28% during the decade, the suppliers' share will increase to 46%. Concerning Győr and its catchment area, these tendencies of development are expected to result in an even more dynamic boom, which will generate a considerable need for R&D activities.

In line with the development of the regional and European vehicle industry, the Knowledge Center considers the predominance of three key aspects as its goal: safety, environmentally friendly operation and economical manufacturing. The research of modern materials and technologies related to vehicle manufacturing and the indication of new possibilities in mechanical constructions both serve the realization of these aims.

The technological research realizing the overall aims embrace the most important primary shaping processes and secondary operations used in manufacturing technologies and finishing processing used in the vehicle industry. Among the primary shaping processes, casting, polymer molding and metal forming operations have a considerable role.

In secondary processes, the key areas are high-speed cutting, hard processing as well as heat treatment and surface techniques. The research on the application of modern surface treatments focuses on tools as well as parts exposed to high temperature and vehicle parts moving on one another. Moreover the whole scope of the manufacturing process is represented in the research profile, including production management and logistics.

The research related to constructions includes the theoretical bases of developing vehicle part-units and the concrete realization of several prototypes as well. Within this the research on gauging bearings and gears, just as the search for solutions resulting in minimum noise emission are given special attention. Vehicle unit development is oriented towards new axle solutions and their main fields of application are agricultural power machines and vehicles.

Computer simulation plays a key role in both technology development and construction, which is highly useful in both modeling technological processes and in solving complex problems connected to flow and thermal conduction that take place in vehicles. The simulation laboratory that is uniquely complex in the region, aims at applying and further developing these techniques. This lab demonstrates a new quality in technology development and in the realization of "design for manufacturing" constructions by integrating the CAD and FEM procedures.

The strategic aim of the center is to create world-class research potential in the outlined research field at the knowledge base of Széchenyi István University, with 8-10 full-time researchers, the university's lecturers and students, as well as modern research tools and methods. It will help the consortium partners and the companies connected to the Knowledge Center to develop and manufacture products that are competitive on the world market and have a high value added.

Besides, it is one of the Knowledge Center's most important goals that with its emanative effect, it should promote education at the university and continuing professional education at the companies. Special attention is paid to the aim that the applied technologies, the new methods and instruments should efficiently promote undergraduate, graduate and doctoral education, and the scientific workshops should provide an ideal framework for educating young researchers. These goals related to university education are supplemented by achieving excellence in knowledge and technology transfer towards the companies.

# Executive summary

The three-year program of the Regional University Knowledge Center for Vehicle Industry is based on the theory of gradual build-up. The focus point of the first year was competence development: acquiring the comprehensive knowledge related to the research topics, establishing the research infrastructure and achieving initial research results on these bases. In the second year, relying on the advanced research infrastructure and expertise, industrially exploitable results and new applications have been created then in the third year, as a continuation of these developments, new and internationally acknowledged procedures and equipment will be elaborated. They will allow launching new domestic and international projects, elaborating new procedures and patents and the self-supporting operation of the Knowledge Center.

In the second year of the program, the research infrastructure continued to expand at Széchenyi István University and new development results were achieved in line with the set goals. Based on an inquiry conducted about the needs, the geometric dimension testing laboratory was supplemented with a modern roundness geometry system whereas in the field of material testing the purchased scanning electro-microscope and micro-analyzer represents the new quality. Thereby the ability of the measurement labs to serve research and the region's economic sector has been further extended and it is able to satisfy higher and higher levels of needs. The instrument pool intended for the computer simulation of the technologies has been supplemented by software supporting manufacturing development and new, large-capacity workstations have been put to use in order to serve the increased calculation demand.

The human resource development of the Knowledge Center had already been achieved in the first year; in the second year six full-time researchers, seven part-time project leaders, 19 university lecturers and engineers employed with temporary contracts and 14 students per semester can be considered as permanent staff who were complemented by further lecturers involved in the implementation of several projects when necessary. Project management is performed by three full-time employees in cooperation with the university's administrative/economic organization.

The three consortium partners have also fulfilled their research tasks planned for the year 2007. Borsodi Műhely Kft. (Borsodi Műhely Ltd) was engaged in elaborating test environment for the machining center procured in the framework of the project and in developing the production technology. Rába Futómű Kft. (Rába Axle Ltd) cooperated in developing primary shaping technologies and managed the complex activity called "Developing modern vehicle constructions" as project leader. In this framework, several modern axles have been developed. SAPU Bt. (SAPU Lp) stabilized the gas-assisted injection molding technology – realized as a technological development in the first year – during the application in manufacturing. In the second year, they carried out successful research in optimized tool shaping and in the recycling process.

From the summary it can be stated that the professional aims of the second year's activity plan have been achieved according to the scheduled program. The efficient fulfillment of the third (final) year's tasks will be supported by the established effective collaboration, and the modern IT platform and management.

# Organizational structure and management

The Regional University Knowledge Center for Vehicle Industry operates as an individual business unit of Széchenyi István University and belongs to the Rector's sphere of authority. The Vice-Rector for Innovation and Development directly supervises it.

The Founders' Assembly, made up of the top managers of the consortium members, is the primary decision-making body of the JRET. The Steering Committee, commissioned by the Founders' Assembly is responsible for completing the whole project. The president of the Committee oversees the fulfillment of the research tasks. His work is supported by the Scientific Committee, which due to its name, defines the main directions of research and development activities and assesses the results achieved.

The management leader of JRET is the manager director, whose work is supported by a project manager and an economic administrator. Financial settlement is done integrated into the university's economic organization with the coordination of an independent financial administrator. The research projects are overseen by project leaders, who involve the university's lecturers and students as well as external experts in the realization process.

**The composition of the individual bodies is as follows:**

**Founders' Assembly:**
Dr. Tamás Szekeres - Rector - Széchenyi István University
István Pintér - Managing Director - Rába Axle Ltd
László Borsodi - Managing Director - Borsodi Műhely Ltd
Antal Mihalicz - Managing Director - SAPU Lp

**Steering Committee:**
Dr. Imre Czinege – Professor, President of the Steering Committee – Széchenyi István University
Dr. Károly Kardos – Vice-Rector for Innovation and Development – Széchenyi István University
Dr. Károly Szőcs – Director for Business Development – Rába Axle Ltd
Szabolcs Horváth – Technical Manager – Borsodi Műhely Ltd
Zoltán Ódor – Head of the Injection Molding Plant – SAPU Lp

**Scientific Committee:**
Dr. Tamás Réti – Professor, President of the Scientific Committee – Széchenyi István University
Dr. Csaba Koren – Professor, Vice-Rector – Széchenyi István University
Dr. Károly Kardos – Associate professor, Vice-Rector – Széchenyi István University
Károly Falvi – Scientific Advisor - Rába Plc
Dr. Gábor Dogossy – Assistant professor – Széchenyi István University
Dr. Tibor Bercsey – Professor, Institute Director – Budapest University of Technology and Economics
Dr. Tibor Czigány – Professor, Head of Department – Budapest University of Technology and Economics
Dr. Miklós Tisza - Professor, Head of Department – University of Miskolc

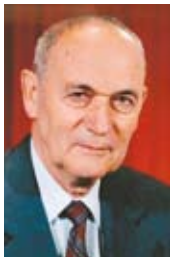
**JRET management:**
Péter Tamás Szilasi – Manager Director– Széchenyi István University
Ildikó Kóbor – Project Manager – Széchenyi István University
Szabina Nagy – Project Assistant – Széchenyi István University
Mária Peterka Németh – Economic Administrator – Széchenyi István University


Dr. Szekeres Tamás


Pintér István


Borsodi László


Mihalicz Antal

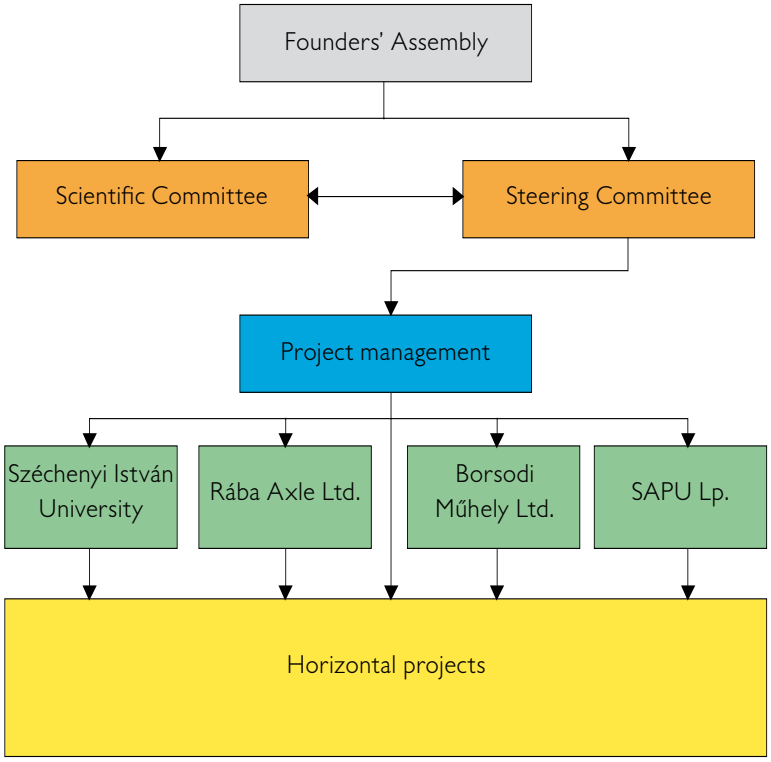

Dr. Czinege Imre


Dr. Réti Tamás

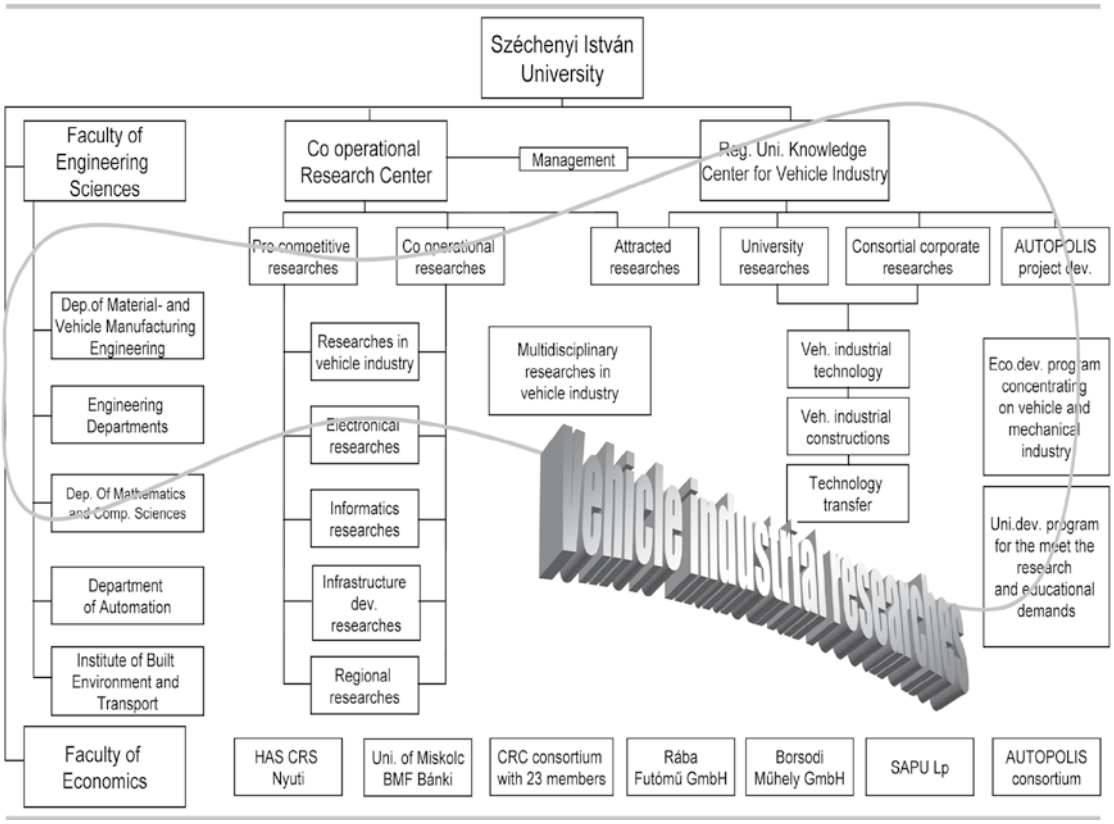

Dr. Kardos Károly


Szilasi Péter Tamás

The relationship between the managing bodies of the Knowledge Center and the organization carrying out the research activities is depicted by the following organizational chart:





# Consortium partners

The leader of the consortium, **Széchenyi István University** is involved in engineering, economics, law, nursing, social work and music teacher education. The university's intellectual capacity and the rate of lecturers holding scientific degrees make the institution suitable for high standard research and development activities. As a result of the above, the university is a dominant institution of the West-Transdanubian region, outstandingly developed in the national comparison, and is closely connected to the economy of Győr and its region, which have the second strongest potential for income production after Budapest. Its main majors rely on the electronic and vehicle industry, which are remarkably strong in the region, moreover on infrastructural development and operation and on the management and international relations of the companies and public institutions working in this field. The university's infrastructural facilities, supplemented by the planned developments, are suitable for the educational and research tasks in the long run.
The corporate partners of the Knowledge Center are the region's significant companies in the vehicle industry, which represent the whole cross-section of the vehicle industry's supplier structure due to the differences in their ownership structure and company size.

SZÉCHENYI ISTVÁN UNIVERSITY
GYŐR



As a traditional Hungarian company, the history of **Rába Axle Ltd** in research and development go back to the beginnings of the hundred-year-old Hungarian vehicle manufacturing. They keep their development activity on a high level still today, which is justified by several innovation awards. The company, employing two thousand people, is present on the world market in several significant product groups. The firm manufactures axles and their components, respectively, for medium-size and heavy trucks, buses and agricultural and power machines. The product scale includes the front, the rear, the driven and non-driven, the steered and non steered and portal axles, their most important components, main units or head assemblies, the differential gears, their gears, the I-beams and the knuckles.


As a Hungarian-owned, stably developing medium enterprise, **Borsodi Műhely Ltd** cooperates in technological development and applications in an efficient way based on their supplier experiences in high technology. Their main strength lies in high-level cutting technology, precision assembly and measurement. Their profile is constantly expanding and through their activities, the aircraft industry also appears as a target field in the work of the knowledge center, alongside the ground vehicles.




Based in Mosonszolnok, **SAPU Lp** (a subsidiary of the Schefenacker company group) supplies internal and external rear-view mirrors to almost all considerable companies in the automotive industry. Their largest customers are MERCEDES, OPEL, AUDI, VW, Ford and BMW. Assembly technology has been developed for 11 years at the firm and the large-series painting of plastic has covered 3 years. As a member of the consortium, they are involved in adapting and further developing modern polymer molding technologies. Within the company group, SAPU set the aim of elaborating an independent rear-view mirror development basis. In this framework, they have created 12 workplaces for researchers and developed an analyzing laboratory.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# Research programs (2006-2008)

## R&D PROGRAM NO. I:

**Research on the manufacturing technology and tools of highly complex, high-quality components for the vehicle industry**

Part task I/1.: Developing modern primary shaping technologies and tools
Implementers: Széchenyi István University, Rába Axle Ltd, Sapu Lp

Part task I/2.: Developing modern cutting technologies and design algorithms
Implementers: Széchenyi István University, Borsodi Műhely Ltd

Part task I/3.: Research on technological solutions for increasing the life span of components and tools in the vehicle industry
Implementers: Széchenyi István University, Rába Axle Ltd

## R&D PROGRAM NO. II:

**Developing modern vehicle main units and researching their diagnostic methods**

Part task II/1.: Research on optimized construction procedures
Implementers: Széchenyi István University, Rába Axle Ltd

Part task II/2.: Developing special axle constructions for agricultural power machines
Implementers: Széchenyi István University, Rába Axle Ltd

Part task II/3.: Developing special axle constructions for utility vehicles
Implementers: Széchenyi István University, Rába Axle Ltd

Part task II/4.: Analyzing the energy flow of the vehicle main units, revealing the correlations between manufacturing technology and reliability
Implementers: Széchenyi István University, Rába Axle Ltd

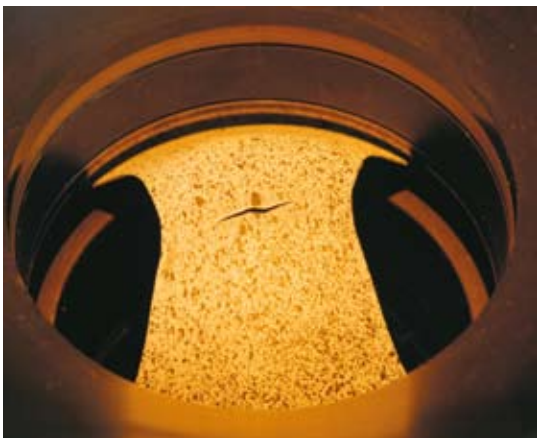
## R&D PROGRAM NO. III:

**Technology and knowledge transfer**

Part task III/1.: Educational and training program
Implementers: Széchenyi István University

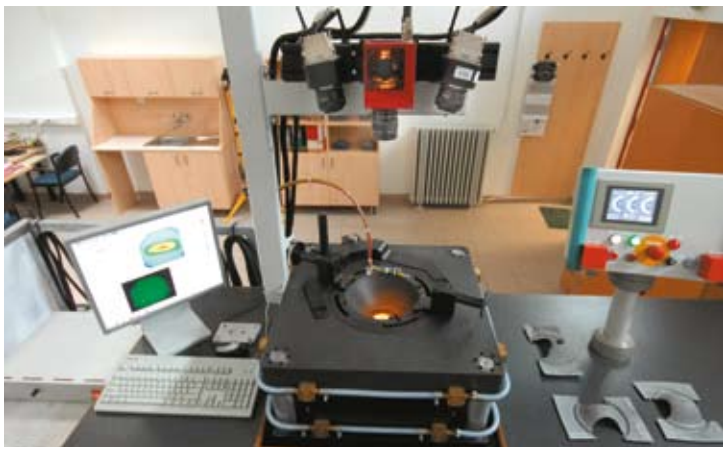
Part task III/2.: Activities supporting R&D tasks
Implementers: Széchenyi István University, Rába Axle Ltd, Borsodi Műhely Ltd, Sapu Lp





# The results achieved by the projects in 2007

Research in the second year of the project was again centered around two professional programs: technology and construction. Their results are disseminated to the two most important user groups – students and corporate professionals – through the educational and technology transfer project. The most important results of the professional programs will be detailed as follows.
In the course of the research on manufacturing technology of automotive components, solutions involving quality improvement and tool life span increase have been found during the computer simulation of cutting and polymer molding technologies. As a result, through the simulation of the forging technology and the optimization of lubrication, tool life span could be increased by 15% and faulty product could be decreased by 20% in the case of several products at Rába Axle Ltd. By introducing the metal deposition welding method, the renewal of worn-out tools has been solved.
With the help of the injection molding simulation software, SAPU Lp managed to make such geometrical changes on new products that facilitate manufacturability and decrease faulty products. Coating the gas valves with nano-composite resulted in a considerable increase of tool life span and the recycling of varnished base material resulted in substantial cost reduction. The research on cutting technology focused on hard machining: as a result, the applicable tools and cutting technology have been experimented at Borsodi Műhely Ltd in relation with the machining of materials used by the air industry. These activities generated surplus revenue of HUF 30 million at the consortium partner, which made it possible to create 3 new workplaces, out of which two are researcher positions. In the interest of improving the experimental testing capacity of the technologies, Széchenyi István University further developed the sheet metal testing equipment and elaborated on a new decision support software for the optimal selection of cold forming tool steels and coatings.
In the topic of modern vehicle main units development considerable results have been attained both in the applied research serving as a basis for the construction work and in the creation of the new main unit. In the theoretical basic research, new computer-aided bearing designing software has been put into application and the application of finite element technique in the creation of new constructions has substantially developed. With respect to experimental techniques, in the field of noise measurement and analysis, the tests calling forth the



reduction of the noise level of the axles and of the whole vehicle have been finished. During the main unit development of agricultural power machines and utility vehicles, two new products have been elaborated in each field and development preparations have been made for further products. The new products already sold a generated surplus revenue of HUF 544 million at Rába Axle Ltd.
The most spectacular result of the technology transfer activity was the **Tech4Auto** international automotive conference and exhibition, organized for the second time. At this event the Knowledge Center and its partners presented the development results achieved in 2007 in 19 presentations. The staff of the Knowledge Center reported on the research altogether in 35 publications and 22 conference presentations: out of these 16 articles were published in foreign periodicals and 7 presentations were delivered at international conferences. The key element of the educational program in 2007 has been to reinforce the scientific background for the newly starting MSc degree programs and to support talented students in the whole scope of education.
Among the indices characterizing the summary results of the research it is worth highlighting that 7 new workplaces have been created out of which 4 are research positions. Twenty-eight new products, services and technologies have been created; the surplus revenue generated by the research is HUF 717 million out of which HUF 554 million is export. In parallel, the consortium partners attained cost reduction of HUF 32 million. Rába Axle Ltd intends to enter a new product at the Innovation Grand Prix contest. All these results demonstrate that the project has achieved its most important goal and has reinforced its positions in the R&D market.

# I/1-1: Modeling and experimental analysis of primary shaping processes

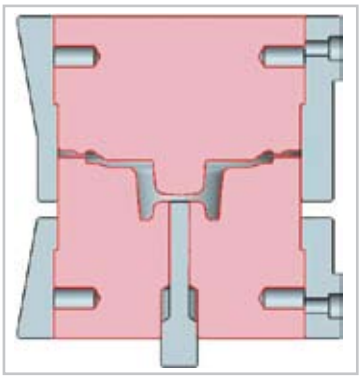
Project leader: Dr. Ernő Halbritter (SZE-AJT)
Subproject leaders: Attila Buczkó, Krisztián Tóth, Gábor Dogossy, Levente Solecki (SZE-JRET), Ferenc Tancsics (RÁBA), Zoltán Ódor (SAPU)

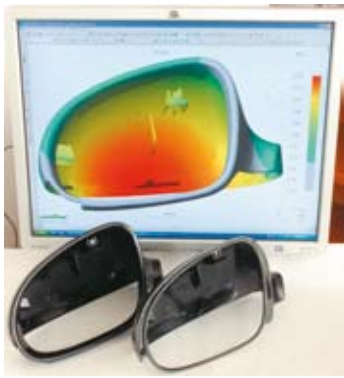
## OVERVIEW

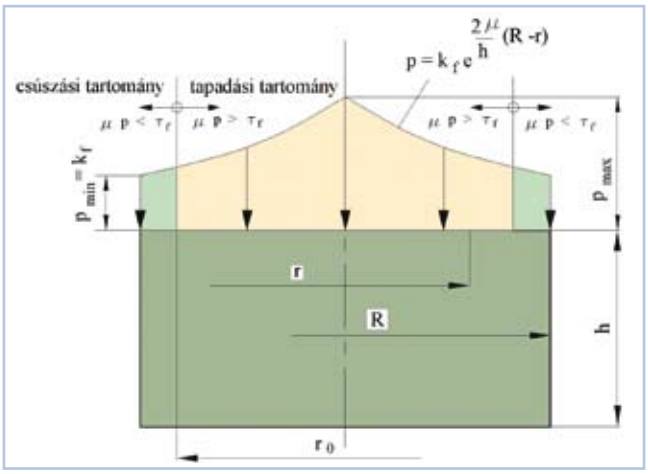
In the year 2007, the researchers used the software of the computer simulation laboratory serving technological and construction development for basic and applied research as well as for operational experimental development. With the aid of the technological process simulation software (AutoForm, Deform 3D, MoldFlow Adviser) sheet metal forming, forging and plastic molding technologies were optimized. Besides the theoretical issues, the frictional processes were also analyzed and experimentally checked. The finite element software analyzing the thermodynamic and flow processes (Hypermesh, Fluent) were used primarily during the development carried out by Sapu Lp, whereas the research on manufacturing process optimization was realized based on the Technomatix software. The details thereof can be found in the individual research projects.

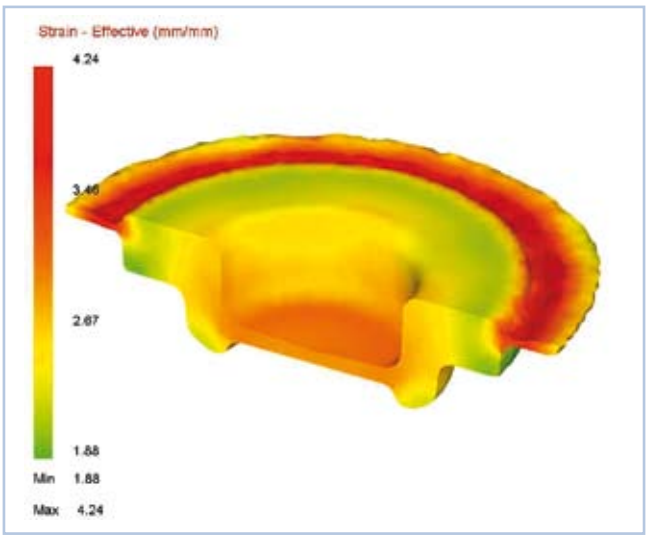
## ACTIVITIES COMPLETED

The phenomenon of adhesion at the preliminary upset applied at multi-step closed die forging was examined via analytical and finite element methods. Out of the input parameters, the expected value of the coefficient of friction was determined experimentally. Based on these theoretical results, during the concrete experiments – out of the factors considerably influencing the value of the coefficient of friction – the micro-geometry of the tool surface was measured with a Taylor – Hobson Talysurf CLI 2000 roughness measuring instrument. A solution of the pattern was found for the unification of forging parts with similar geometry by applying the Pro/Engineer and Deform 3D software. The solution optimizes the force and work needed for shaping and also ensures the constancy of the blank volume.







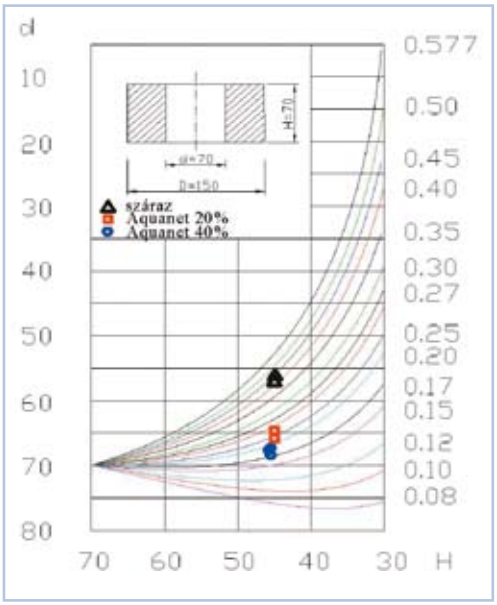



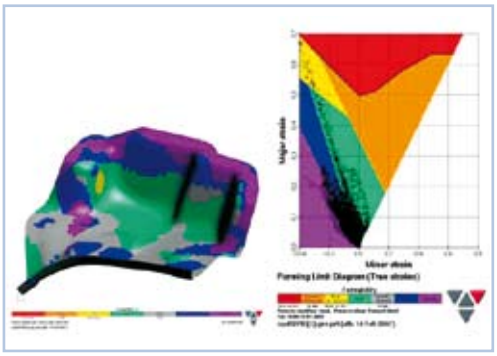
## RESULTS

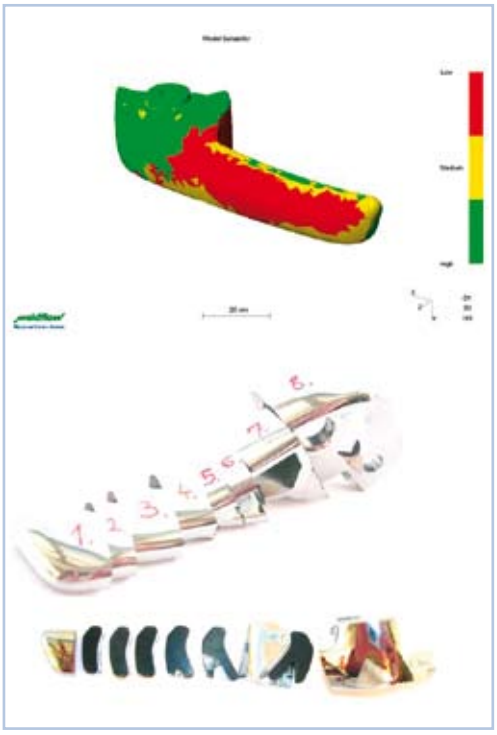
The micro-geometry of the surface of a tool that can be used for experimental purposes and operational application has been mapped and measurements of the coefficient of friction have been carried out for different lubricants. In order to interpret the results in a novel way, a new Burgdorf curve set has been recorded. The mathematical model of material flow has been elaborated for the case of full adhesion. With the integrated application of the Deform 3D finite element software and of a CAD system, it has become possible to show the grain flow illustrating the adhesion. By using the Pro/Engineer and the Deform 3D software, respectively, a solution of the pattern has been found for the unification of forging parts with similar geometry, which has been tested and now applied in manufacturing at Rába. During the assessment of our results attained we stated that in order to move forward, it is by all means necessary to further build our competencies in the field of finite element software.

## FUTURE TASKS

To further integrate the computer simulation systems with the CAD systems, to elaborate optimized technological design methods. To spread out the applications within the circle of consortium partners and other enterprises. To expand the simulation activity in the interest of further improving the knowledge base already acquired and to master the application of the newly purchased finite element software for the preparation of the simulations and for the evaluations of the results gained.





# I/1-2: Research on primary shaping technologies and tools

Project leader: Dr. Károly Kardos (SZE-AJT)
Sub-project leaders: Dr. Imre Czinege (SZE-AJT), Dr. Mária Kirchfeld (SZE-AJT), Ágnes Böröcz (SZE-JRET)

## OVERVIEW

Based on the development carried out in the first year, in 2007 the development of sheet metal forming technologies and tools as well as the testing of sheet metals brought results of applied research. The extension of the newly elaborated sheet metal testing equipment to modern sheet metal materials and to higher-temperature tests has opened up new opportunities in forming technology development. The complexity of the laboratory instruments and the level of the simulation software made it possible to create an integrated sheet metal forming technology development system that, beyond its theoretical significance, can also be used for solving industrial tasks. The examination of the materials of the small batch size sheet metal forming tools and the analysis of the wearing processes has been continued through international cooperation.



## ACTIVITIES COMPLETED

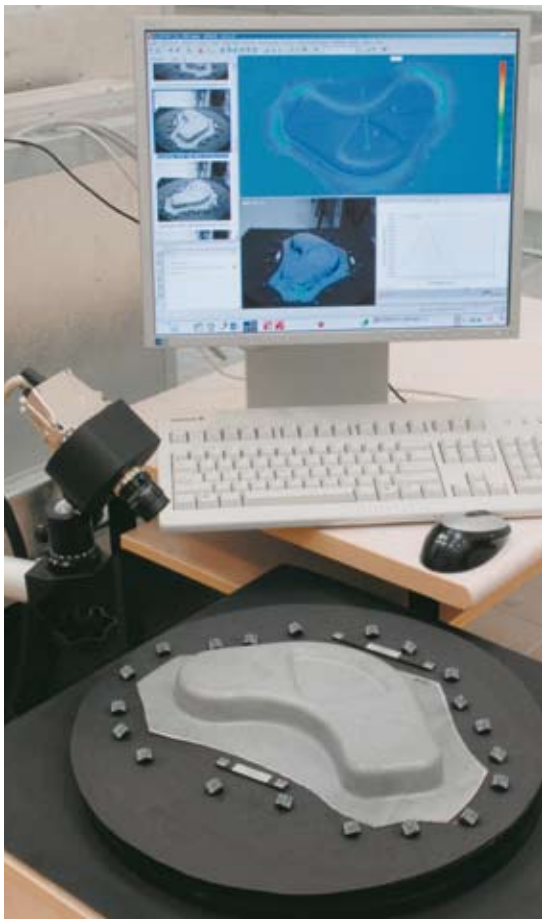
The sheet metal testing device elaborated for testing sheet metal characteristics has been further developed for higher temperatures and for the field of high strenght sheet metals. The development of the integrated sheet metal forming technology development system has been completed and we managed to test its operability in research based on our own capacity and in corporate applications as well. The life span tests carried out on metal, plastic and galvanic-coated plastic tools have been complemented by computer simulations helping the interpretation of the results.

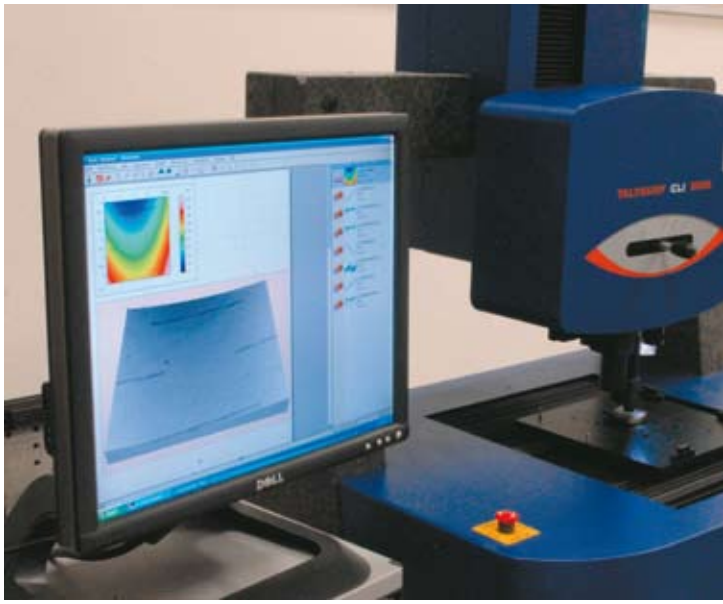
## RESULTS

The sheet metal testing equipment and the other equipment purchased in the framework of the project have been applied in the complex testing of the strength, anisotropy and formability of sheets used in the automotive industry. The two most significant industrial partners in this issue have been Audi and Suzuki. The integrated technology development system has been successfully tested at Ajkai Electronics Ltd. The successful completion of the research on tool life span and the publication of the results have opened up the way to international cooperation, in the framework whereof the university participates in the submission of a FP7 tender and further projects are also under preparation.

## FUTURE TASKS

To apply the elaborated analysis technique and technology development know-how in order to solve industrial tasks. To develop new technologies of analysis and complex features for automotive applications. To extend the experiments on tool life span to further couplings of materials and technologies. To theoretically develop and experimentally check blank sheet optimization.



# I/1-3: Research on the production technology of polymer components

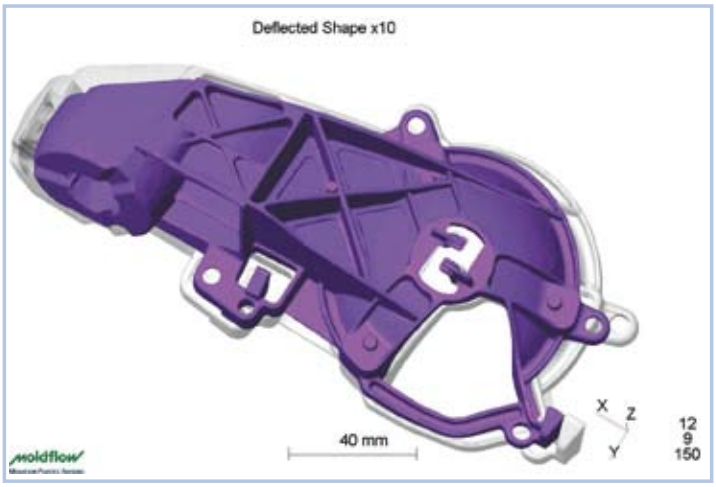
Project leader: Zoltán Ódor (SAPU)
Sub-project leaders: Dr. Gábor Dogossy assistant professor (SZE-AJT), Péter Staszny (SAPU)

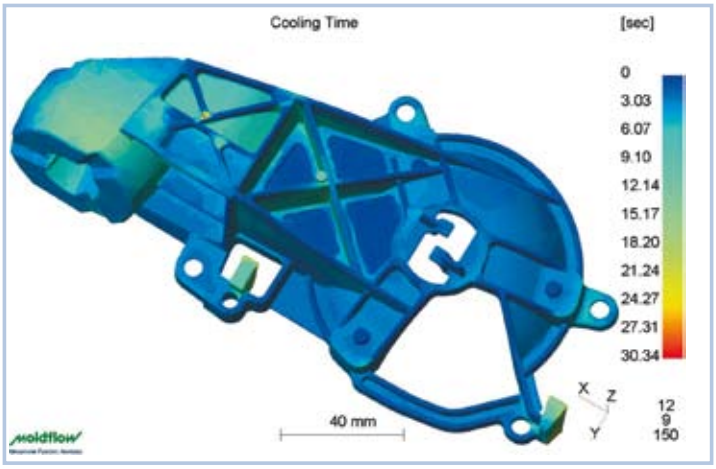
## OVERVIEW

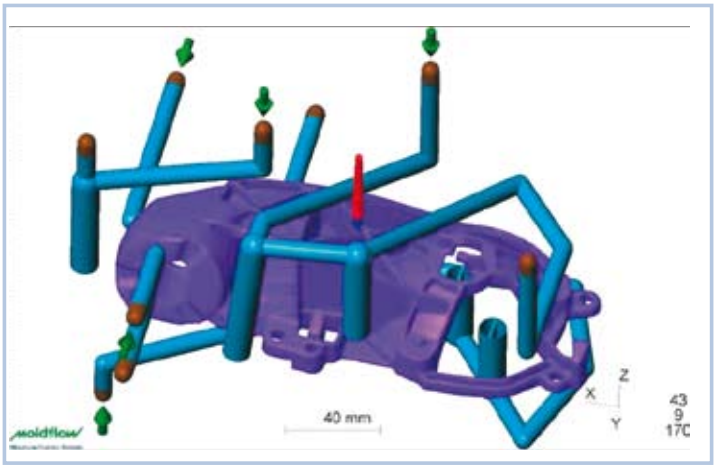
In 2006 the project was aimed at the complex research on gas-assisted injection molding technology and at the establishment of its pilot environment. As a result, the conditions of the technology's operational application were created and production started. In 2007 the problems related to manufacturing and toolings were solved. The first partial research task was to elaborate a process for recycling the scrap created during injection molding and varnishing. The other two topics were the optimization of the varnishing and injection molding process, during which the conditions of applying nano-composite treatment and the optimization of the injection molding cycle were in the focus of the research.

## ACTIVITIES COMPLETED

In order to determine recyclability, we examined the modifying effect of the grind and granulate characteristics in regards to the original material, in the case of blends with a certain mass%. It was done on one hand by measuring the standard mechanical properties (tearing, bending and Charpy impact tests) and on the other hand by measuring the products received as a result of the test production (drop-pike test, varnishability). We analyzed these characteristics in the case of unvarnished regranulate as well. In the interest of optimizing the gas-assisted injection molding, we coated the gas valves with nano-composite varnish and examined the number of times maintenance was necessary. In the case of products to be launched, geometrical optimization was executed with the aid of the Moldflow software. Within the company group, SAPU established an individual rear-view mirror development base, during which they created 12 workplaces for researchers and test laboratory.



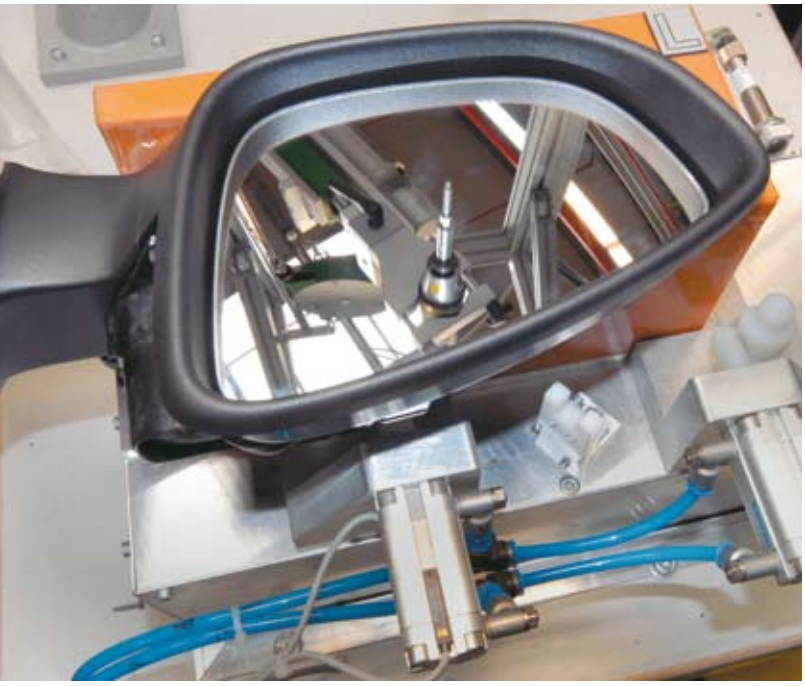



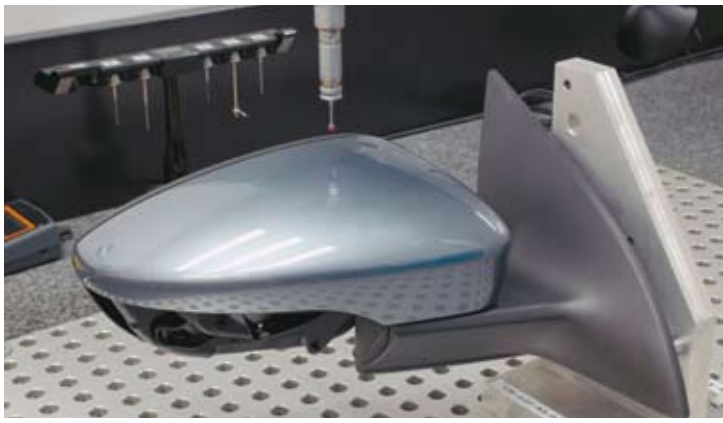
## RESULTS

It is possible to recycle the injection molding scrap even in the form of a high mass% blend with the limits of application that have been defined. However in the case of reapplication of varnished scrap, the resistance of the blends to dynamic wear and tear has considerably decreased compared to the original material. Varnishing with a light color can also be inconvenient because of the varnish particles left over and getting onto the surface. So recycling varnished products have to be kept under the technologically possible mass% blend and maximum mass% can only be applied in the case of a dark cover varnish. The limits thereof have been set. The coating of gas valves with nano-composite has resulted in a considerable improvement as the original need for maintenance has decreased by a third. With the help of the injection simulation software we can execute such geometric changes on the new products that facilitate manufacturability. In addition we have also determined the optimal manufacturing process as a result whereof the necessary injection molding capacity has become schedulable.

## FUTURE TASKS

To introduce the recycling process for all the material types used. To further apply the injection molding simulation before launching new projects. To apply the research to development tasks and to have the laboratory accredited.



# I/2-1: Research on cutting technologies

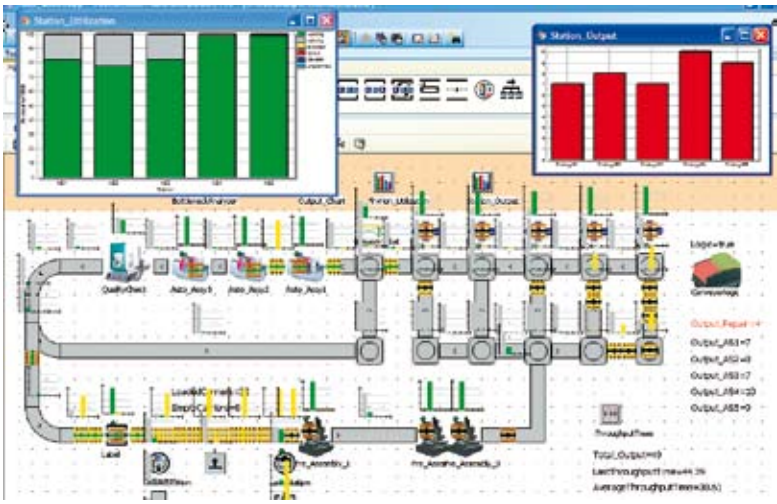
Project leader: János Jósvai (SZE-JRET)
Sub-project leaders: Mrs. Ferenc Csizmazia dr. (SZE-AJT), Márton Barbély (BORSODI)

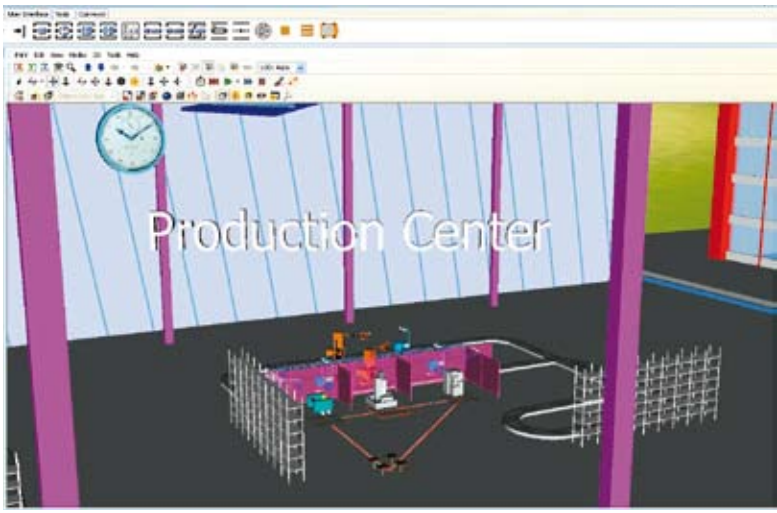
## OVERVIEW

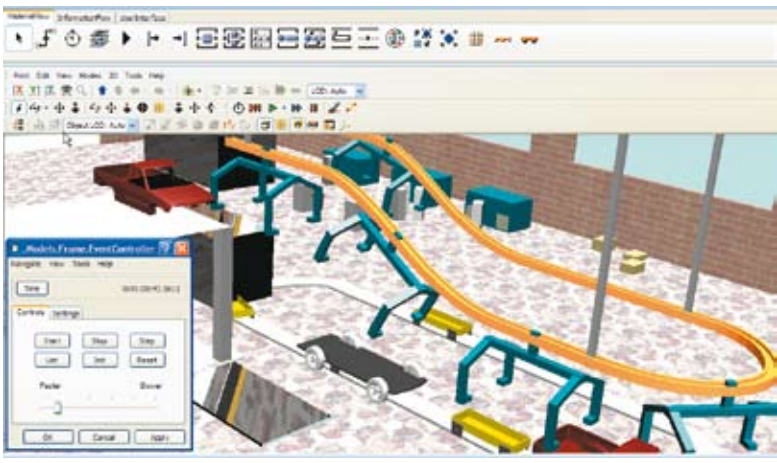
The research on cutting technologies done in 2007 can be divided into two main areas. In the field of research on aircraft technologies and materials, the technological plans and specifications of the corporate material-testing laboratory serving production have been prepared in cooperation with Borsodi Műhely. Further research and testing has been done for the selection of the hard-to-machine materials to be applied in the air industry and of the tools that can be used for them, in special consideration of hard machining. In the specific research area of machining process simulation and research on manufacturing process planning algorithms and software, theoretical and application advancement has been done in 2007. In the field of simulation software the Tecnomatix-Jack and Plantsimulation program package suitable for ergonomic testing have been mastered and applied.

## ACTIVITIES COMPLETED

The analysis containing the instruments and testing procedures of a material testing laboratory meeting the requirements of the air industry has been completed, based on which the realization of the laboratory is under process. The materials and technologies applicable during hard machining have been determined. In the course of practical application of simulation processes, small-scale production has been mapped in an automotive environment. Furthermore the discrete processes of the material flow system have been modeled, during which it was necessary to take stochastic parameters and system elements into account. In the field of production process planning, research and analysis has been done to elaborate a procedure suitable for generating an optimized production program taking into account the manufacturing technology, warehouse capacity and stocks and order needs of a limited-capacity pressing plant.





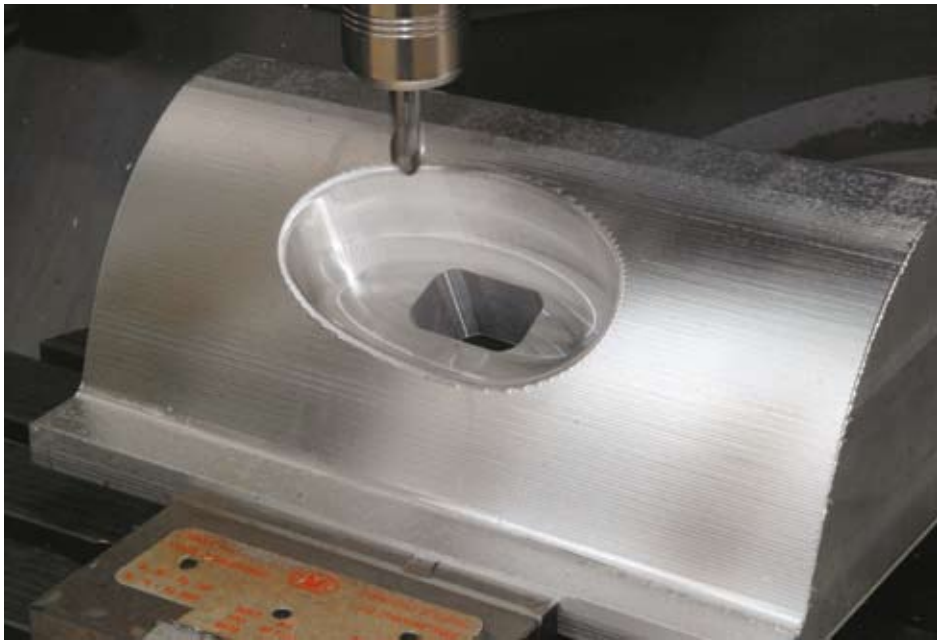



## RESULTS

An experimental testing technique has been created for operational application. The tools and cutting technology that can be applied with respect to the materials used by the aircraft industry have undergone experimentation. In the area of production process planning, a procedure serving the design of an optimized production program has been developed through the research of scheduling and warehousing procedures. In the field of simulation, procedures of small-scale production modeling have been mapped moreover a conference presentation has also been held in this topic. Some advancement has been made in the research of the possible modeling procedures of stochastic systems.

## FUTURE TASKS

In the field of material testing, the task is to examine the special material features that may arise in the future and to analyze their machining technologies. In the area of manufacturing process analysis, the aim is apply the layout-design procedures and the possible software tools serving for technological process modeling together and to do research and development on the design algorithms enabling the common application of these tools. We wish to disseminate the results attained in the fields of material testing and production process design and scheduling within the circle of our industrial partners in order to support their development through application.

# I/2-2: Research on multi-axe machining

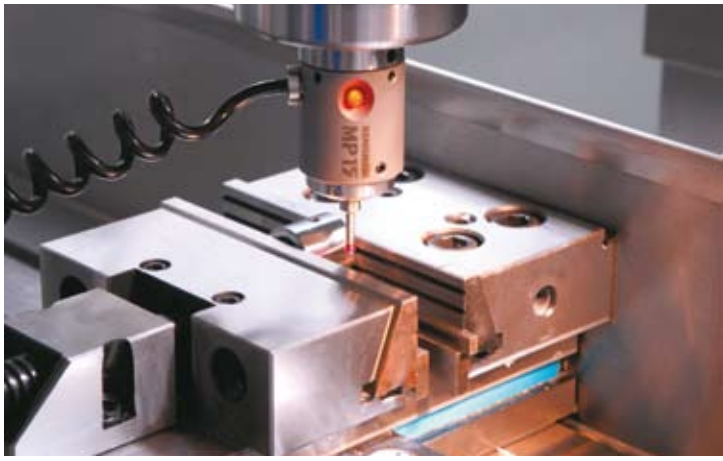
Project leader: Szabolcs Horváth (BORSODI)
Sub-project leaders: Zsófia Kőhalmi, Gábor Ónodi, Szabolcs Lendvai (BORSODI)

## OVERVIEW

In 2006 Borsodi Műhely Ltd established a test environment for carrying out 8-axe cutting experiments. Having acquired the technological know-how, the equipment has been running continuously. The research task for the year 2007 was to elaborate a test environment and a technology for hard machining. In this framework, cutting experiments were carried out on four characteristic cold forming tool materials and the results were assessed.

## ACTIVITIES COMPLETED

Installing and putting into operation a machining center suitable for hard machining. Elaborating an experimental program for tool selection and for the optimization of technological parameters. Carrying out cutting experiments on K8, M1, STAVAX and case-hardened BC3 steels. Recording a heat map during cutting, and qualifying the machined components. Processing and assessing the results of the technological experiments. Based on the results, elaborating a database of the optimal technological parameters. Based on the experimental results, indicating the directives of cutting technological planning and the methods of defining the technological parameters in Borsodi Műhely Ltd's documentation system. Designing the heat treatment and material testing methods to be applied before hard machining, elaborating their processes and creating a base for the necessary investment.

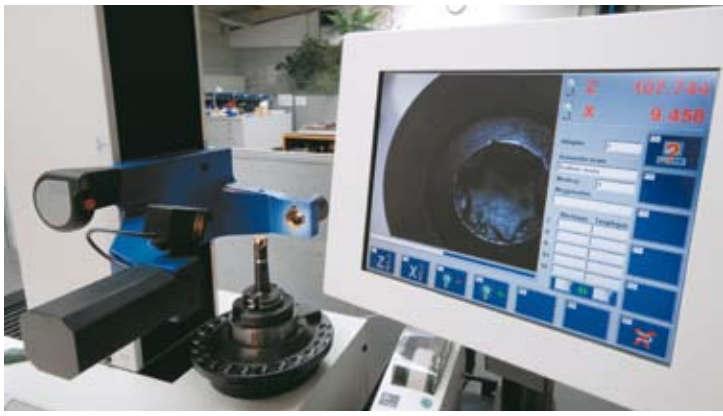



## RESULTS

Elaborating an optimal cutting technology for specific cold forming and polymer molding tool materials and the knowledge of the effect of multi-axe machining on the machined surface. By producing machining reference components, justifying the efficiency of the technologies, expanding the own-profile and supplier activity to the area of tool manufacturing.

## FUTURE TASKS

Based on the elaborated new cutting technology, to increase the circle of machinable parts and to acquire new markets. To further develop the conditions of hard machining, to adapt a new heat treatment technology and equipment, and to elaborate a heat treatment technology for modern ground vehicle and aircraft components.

# I/3: Research on surface technologies

Project leader: Dr. Tamás Réti (SZE-AJT)
Sub-project leaders: Imre Felde (BAYATI), Ferenc Tancsics (Rába)

## OVERVIEW

The two main fields of the application of surface technologies in the vehicle industry are the surface treatment of vehicle structure elements and of the tools manufacturing the components. In the first year research was focused on compiling a scientific database that contained the main coating types and surface treatments, respectively, as well as their optimal application. In the second year, the database has been completed with the full range of cold-forming tools and with data containing their heat treatment parameters and characteristics. Moreover a selection strategy has also been prepared for determining the optimal tool material and coating. In parallel, research has been done in Rába's forging workshop with respect to the wear and surface treatment of hot-forging tools.

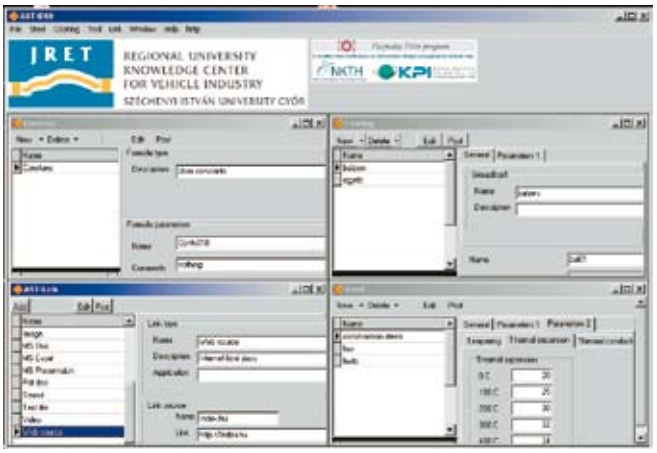


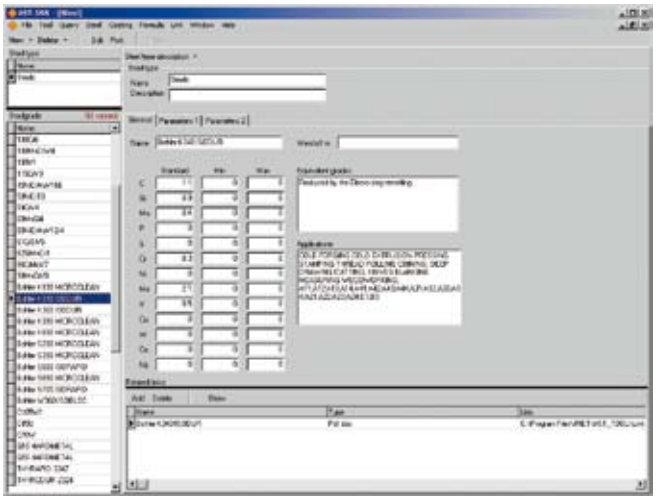
## ACTIVITIES COMPLETED

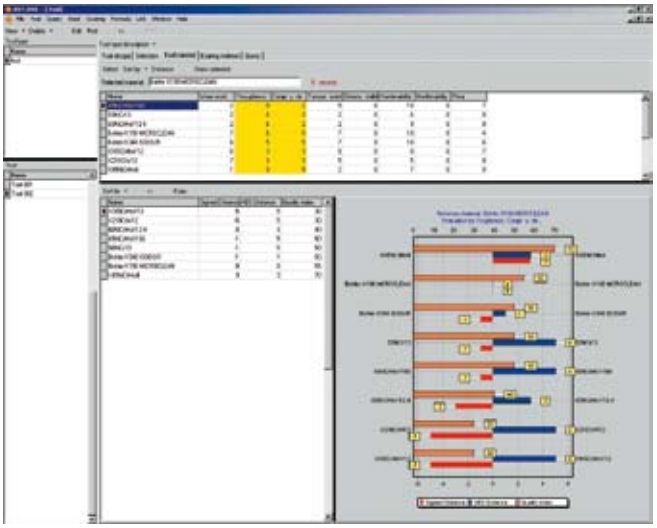
Classifying the surface techniques and coatable components according to their function, material, utilization and coating type. Setting up a system of rules, turning it into an algorithm and connecting it with the information base of the cold-forming tool materials. Connecting the technological database and the applications database. Experimental testing of the possibilities of increasing the life span of closed die forging. Wear analysis, modeling the wear process with computer simulation, developing a pressing force measurement system, comparative analysis of lubricants, and renewing worn surfaces by applying metal deposition.

## RESULTS

The established decision support system approaches the topic of surface techniques, material selection and their application in a modern way. The test results of the elaborated software show that the tool material database can be developed into a marketable product after completion. Through the simulation of the forging technology and the optimization of lubrication, tool life span could be increased by 15% and fault products could be decreased by 20% in the case of several components. By introducing the metal deposition welding method, the renewal of worn-out tools has been solved.

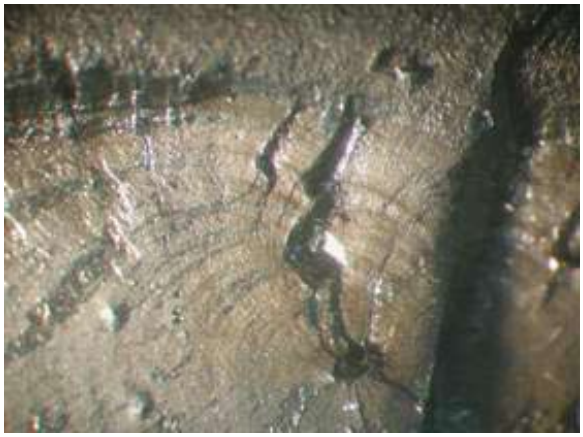


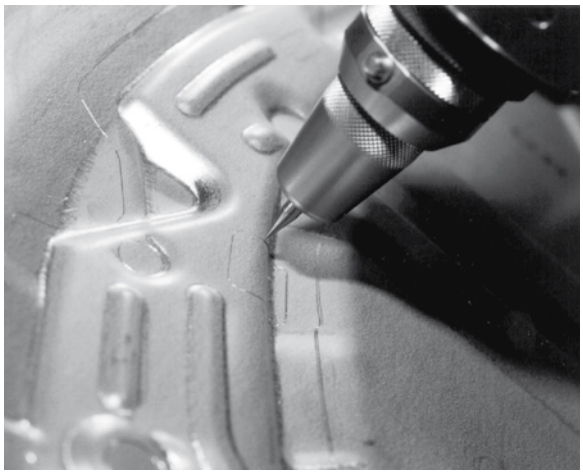



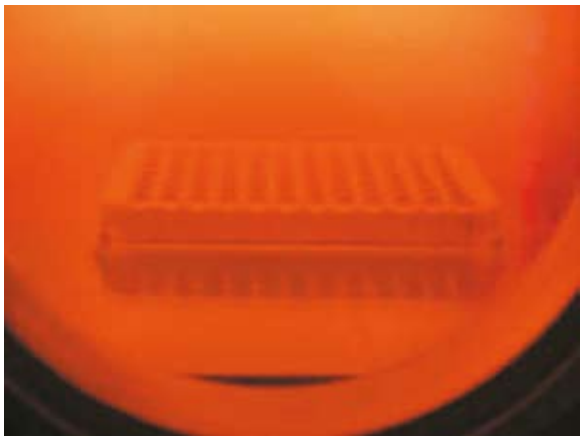


## FUTURE TASKS

To expand the elaborated knowledge base with the data of the hot-forming and polymer-molding tools. To elaborate a selection algorithm for the new fields of application and to test them through operational experiments. To extend the life span calculations of the closed die forging tools to hot extrusion presses, to expand the application of wear simulation, and to extend the metal deposition technology to further applications.







# II/1-1: Research on optimized construction procedures

Project leader: Imre Herczeg (RÁBA)
Sub-project leaders: Dr. Ernő Fülöp, László Légmán, István Molnár, László Varga (Rába), Dr. Péter Horváth (SZE-MGT)

## OVERVIEW

The project deals with three substantial design procedures of vehicle part unit development, which include: finite element calculation based on fatigue estimation measurements, the development of the geometry and manufacturing of low noise-level gear boxes and the computer-aided design of multi-point build-in bearings. All three subprojects include both theoretical and experimental work, which help verify the results. In the first year the projects brought initial results whereas in the second year, the majority of the research resulted in solutions that can be applied in practice.

## ACTIVITIES COMPLETED

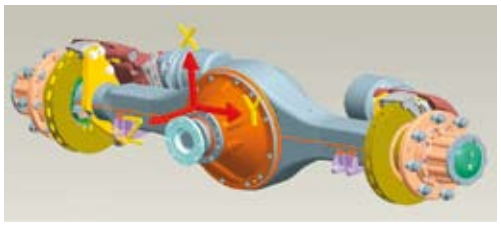
In the topic of fatigue, the test specimens have been produced from the St-52.3 sheet metal used in the construction design of axles and with the surface treatment applied in operational practice, the tests have been carried out and they have been evaluated. In the topic of noise tests, the hypoid and spiral cone disc wheel connections built into bus axles have been examined, and installed into Credo IC11 and IKARUS 260.32 buses. The aim of the testing was to determine the relationship between cab noise and axle cogs. In the topic of bearing design, the dimensioning algorithm and software have been completed for triple-bed and pre-stressed cone-wheel bearings.

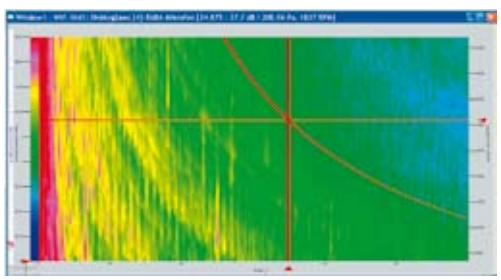
## RESULTS

In the topic of fatigue, the database has been supplemented with experimental results, which contains the most important information necessary for axle development. Through this, the conditions have been created for the design of bridge houses and other structural elements, optimized for fatigue supported with a finite element process. From the results of noise measurement, we managed to identify two key parameters, the eccentricity of the axle-shafts and the basic harmonic of the cog connection that have a determinant effect from the aspect of noise- and vibration levels. Based on these, the first versions of the cogs optimized for noise have been prepared. The computer program elaborated in the topic of bearing dimensioning has been successfully tested and the basic goals have been met, however the research pointed out that it would be practical to further develop the traditionally accepted cog force calculation method.

## FUTURE TASKS

The next step in the research on fatigue is to finish the fatigue experiments and to set up generalized relations in design and to implement them in operational practice. In noise testing research, the relationship between micro-geometry and noisiness will be further analyzed and the prepared hypoid and spiral gears optimized for noise will be tested in vehicles. It is based on these tests that a design and manufacturing methodology will be created, which – through the perfection of gears – can further reduce the noise level of the body elaborated so far. In the course of further developing the bearing design algorithm and program, the cog force calculation module will be perfected through which a design precision improvement of 15% can be attained.



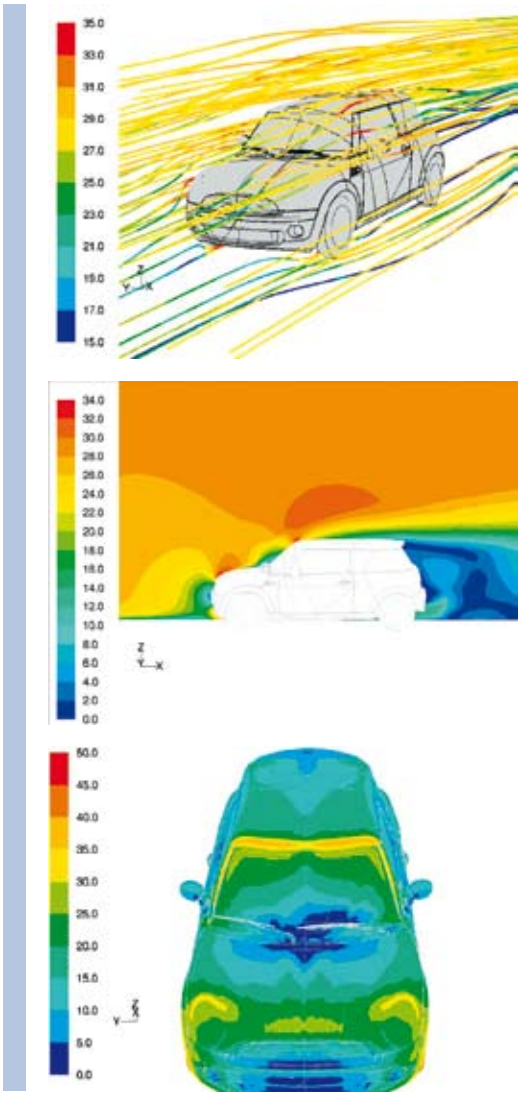


# II/1-2: Research on optimization algorithms of vehicle main units

Project leader: Dr. Zoltán Horváth (SZE-MSZT)
Sub-project leaders: Tamás Morauszki, Krisztián Tóth (SZE-JRET)

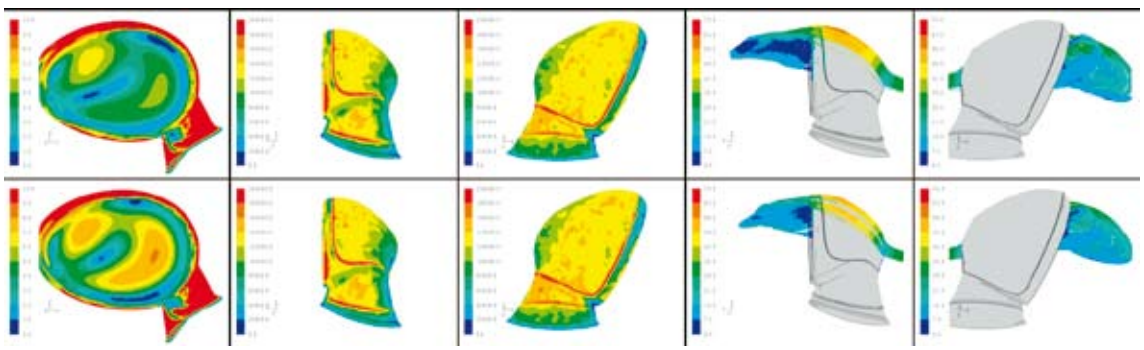
## OVERVIEW

During the second year, the research related to automated product development, started in the previous year, continued. Its essence is to integrate the product development steps based on computer simulations, namely the development cycles "CAD modeling – finite element analysis – optimization". In the framework of the project, applied research tasks have been completed and the results have been published in the following topics: further development of the geometrical dimension optimization algorithm of flow channels; development of an optimized tolerance field calculation algorithm; research on the flow of gaseous and liquid substances, particularly on vehicle engines; and analysis of the noise generated by outdoor vehicle mirrors, extending the research of flow problems to acoustic phenomena.



## ACTIVITIES COMPLETED

During this year, CATIA V5 has also been processed in addition to the already integrated CAD software (Pro/ENGINEER) so the application scope of the simulation system has considerably been widened. The optimization framework has also been developed, which resulted in a safer and more reliable operation of the system. A new method, namely polyhedral meshing has been put into use in network generation, which is considered to be a key element of finite element analysis. In collaboration with Deutz AG (Cologne, Germany) and in connection with the exhaust pipe system, we studied the effect of preparing CAD-geometries with different parameters of optimization. The aero-acoustic examination testing of vehicle mirrors has been realized in cooperation with SAPU.

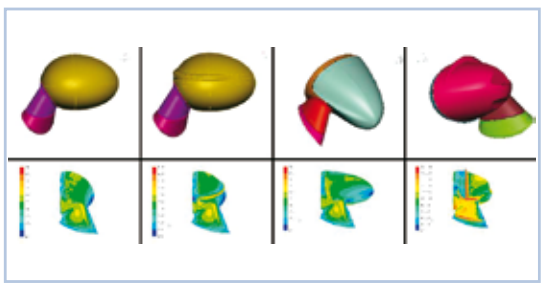


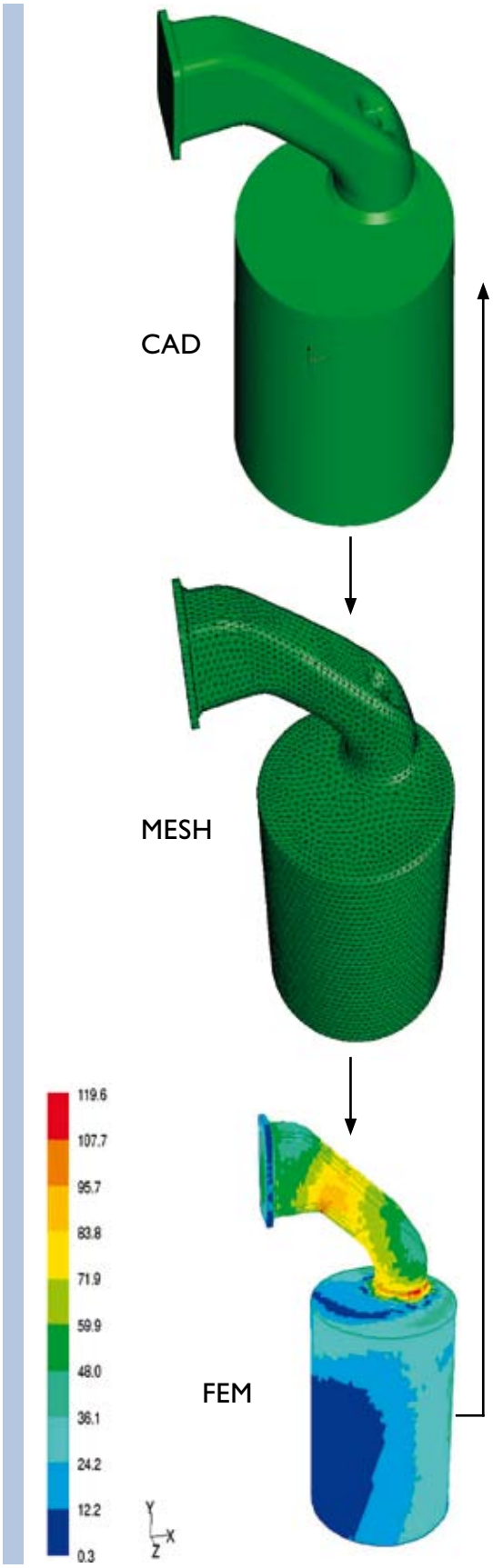
## RESULTS

As a result of the CAD-FEM integration based on computer simulation, the experiments run can be executed automatically without any human interference. Thereby the calculation time is substantially reduced and the efficiency of the simulation increases. The new optimization framework has resulted in the safer and more reliable operation of the system. By applying polyhedral meshing, it became possible to create a mesh containing much fewer cells from a typically applied tetrahedral meshing, through which the running time of the analysis will be substantially reduced on the new mesh created. An important experience of the Deutz cooperation is that the success of optimization depends on the CAD-model stability of the initial parameters and on the possibility to generate varied shapes. During the aero-acoustic examination testing of the vehicle mirrors, a mesh of 16 million cells could be handled – the work and the calculation was enabled by using several workstations and connecting them into a parallel network. Thereby the methods of acoustic analyses have been continuously refined. When assessing our attained results, we stated that in their tendency, they are in conformity with the measurement results and are suitable for determining average noisiness. For a more accurate simulation, however, it is by all means necessary to further improve in the field of finite element software, namely to purchase more accurate acoustic analysis software.

## FUTURE TASKS

In the final year of the project, one of the main aims is to finish the acoustic analyses, to assess the results and calculation methods and to generalize the conclusions drawn. In order to attain this, it is indispensable to master the application of the newly purchased software, to apply them, and to compare the results with the measurements. Through the development of CAD-modeling capabilities industrial application of the automated, CAD-based optimization will also be further developed.





# II/2: Developing special axle constructions for agricultural power machines

Project leader: Andor Opitz, Mátyás Andrási (RÁBA)
Sub-project leaders: Jenő Petőfalvi, László Simon (RÁBA), Dr. Zoltán Varga (SZE-KVJ)

## OVERVIEW

The project started in 2006 in the topic of further developing the axles of agricultural power machines and making them able to transmit higher power. These aims were fulfilled by elaborating a new construction for the planetary gearbox and by manufacturing the wheel hub planetary gear through a more advanced technology moreover by optimizing the steering system. In the second year, Rába have carried out the necessary subsequent adjustments and the mass production of the axles has started in both cases.

## ACTIVITIES COMPLETED

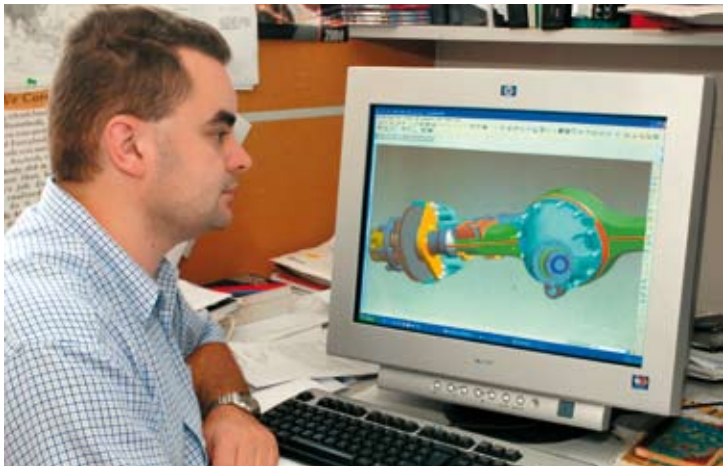
The construction development of tractor axles of two power categories: the increase of power from 320 HP to 360 HP in the case of one power machine and in the case of the second tractor, the increase of power from 500 HP to 550 HP and the increase of steering momentum by 80%. The testing of the first construction on the test bench and through field tests has been completed and the second development has been carried out in three versions; out of these, the third solution could meet the specified requirements.

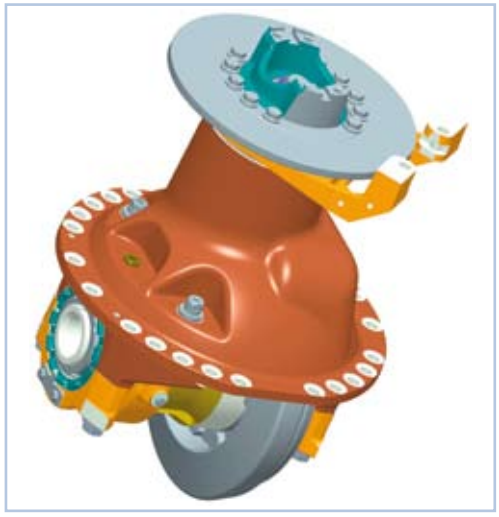
## RESULTS

During the testing that reached different phases, the new axles met the expected quality requirements, and the results of the life span tests were positive. The technology applied in the manufacturing of the newly constructed planetary gear proved its high quality level during the operational tests of the axles as well. Therefore Rába acquired two constructions through which they will be able to maintain their competitiveness on the world market. In parallel, the new elaborated design procedure based on a simulation technique as know-how will enrich the company's development abilities.

## FUTURE TASKS

To extend the new development results now applied in mass production to other axles. To continuously develop products suiting the market needs.





# II/3: Developing special axle constructions for utility vehicles

Project leader: Kálmán Rákóczy (RÁBA)
Sub-project leaders: László Hódos, László Légmán, Zoltán Mészáros, János Samu, (RÁBA), Dr. Zoltán Varga (SZE-KVJ)

## OVERVIEW

In the first year of the project, the Rába axles were considerably developed in the case of all three utility vehicle families: buses, trolleybuses and truck axles. In the year 2007 we focused on the concentrated development of the front and rear axles of military vehicles, in three phases. The activity was focused on computer-aided design and the application of modern manufacturing procedures: these up-to-date tools made it possible to adapt to the changing market needs in a flexible way.

## ACTIVITIES COMPLETED

In the first phase of development, pairs of driven and steered front and rear axles with a 13,000-pound axle-load were elaborated with air-operated Rába drum brakes for 4x4 vehicles. In the second phase, the customer asked for a 20% increase in axle load, which was successfully executed. In the third phase a central tire inflation (CTI) system was developed for the new construction. In the course of development, Rába elaborated a modular bridge house construction that assures further flexibility in design.

## RESULTS

The further developed pair of axles has met the fast-changing market requirements, which in fact is supported by the acceptance of the prototypes and the take-over of twenty kits. With this development, Rába managed to hold on to their position in the vehicle part unit supplier segment. All the new constructions were designed with up to-date CAD tools and finite element technique, the conformity whereof were justified by the laboratory fatigue tests and operational experiments carried out after trial production.

## FUTURE TASKS

The second year's subproject has been completed, now the aim is to transmit the development results into manufacturing and to reinforce the product's market position. The development in the third year will aim at the elaboration of higher axle load members within the axle family; it includes elaborating and testing the prototype.

# II/4: Analyzing the energy flow of utility vehicle main units, revealing the correlations between manufacturing technology and reliability

Project leader: Dr. Zoltán Varga (SZE-KVJ)
Sub-project leaders: Dr. Csaba Tóth Nagy (SZE-KVJ)

## OVERVIEW

In the first phase of the project, connected to the Rába developments, those theoretical relationships had been revealed, which were necessary for developing increased-speed axles supporting the faster public road traffic of agricultural power machines and these relationships were displayed during the development. In the second year deeper research was done on driven axles with independent wheel suspension, in the framework whereof specific calculations have been done for the loads arising in the various operational modes of a given vehicle (plowing, hauling). It was followed by the calculation of the load derived from the drive dynamics characteristics for the individual elements of the steering wheel structure. The third part of the project was oriented to experimentally test the friction between the modern wet disk brake lamellas used by Rába, namely to test the process of heat generation. In 2007 analysis was done on the feasibility of a new HCCI engine, the final aim whereof is to develop a homogenously charged and compression-ignition engine. The operation of the engine can be regulated by changing the conditions of compression, which is realized by continuously adjusting the length of the crank radius during operation.

## ACTIVITIES COMPLETED

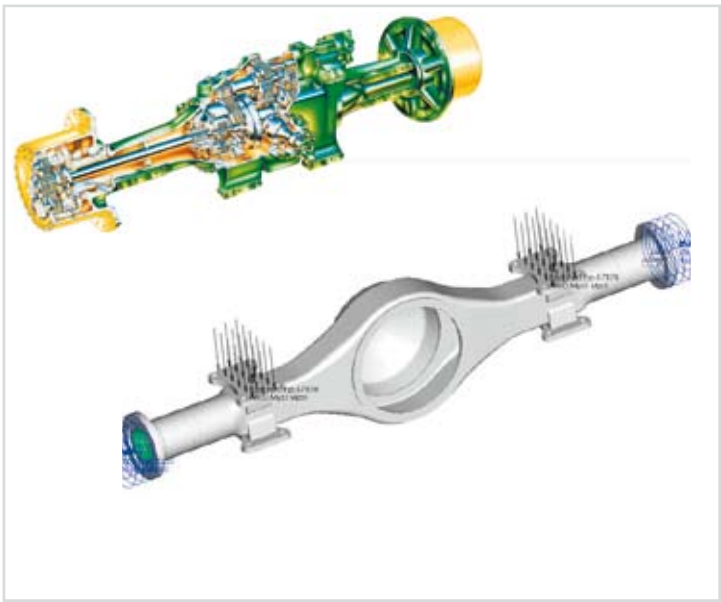
The forces affecting the suspension pins of the tractors with independent wheel suspension have been calculated and the dimensions of the structural elements have been determined. The force affecting the steering wheel structure of a rubber tie-beam tractor and the load of the hydro-engine have been determined. We have achieved the energetic analysis of the break inserted into the drive-chain, the definition of the heat map of the structural elements and the deduction of the mechanical losses from there. In the topic of engine development, the mechanical operation of an engine has been computer simulated and an engine that can be used for the experiments has been purchased. Moreover the HCCI engine has been designed and the components have been manufactured.

## RESULTS

Based on the theoretical results, a calculation method has been elaborated for the suspension ball-pivot forces of the parallel track-arm axle and the ball-pivot forces have been determined under different operational conditions. Satisfying the new demands has reinforced the market position of the rubber tie-beam axle, one of Rába's most successful products. A new measurement and assessment procedure has been elaborated in order to determine the mechanical losses of structural elements. The part units critical from the aspect of warming have been identified. The mechanical simulation of the HCCI engine was completed with positive results.

## FUTURE TASKS

To continue elaborating new construction concepts for the axle design tasks of heavy-duty agricultural power machines. To decrease mechanical losses by analyzing the critical parts of the axle with respect to energy efficiency and to do research on new construction solutions. In the topic of engine development, to map the operational fields of engines, to elaborate the regulation and to conduct experimental measurements on engines together with data collection and processing.



# III/1: Educational and training program

Project leader: Dr. János Égert (SZE-MGT)

Subproject leaders: Persons responsible for the majors and the subjects (SZE)

## OVERVIEW

The educational and training project embraces the transfer of the results of the research and infrastructure development going on in the JRET into undergraduate, graduate and doctoral education as well as into corporate trainings. In 2007 JRET introduced a talent program, the forms whereof appeared on the full educational spectrum. The system of professional relations of the Doctoral School for Multidisciplinary Engineering Sciences and of the JRET has been further expanded. A supplementary activity was to involve the students in the implementation of the JRET projects in the framework of final theses, scientific student work or part-time employment. The Knowledge Center sponsored an independent student tender in connection with the student competition, "Széchenyi Run", in the course whereof they provided spare parts and part units for two student vehicles, moreover supported the further development of the vehicle entered by the Railway and Road Vehicles Department for the purpose of experiments.

## ACTIVITIES COMPLETED

In connection with the "Computer science" major, professional support has been provided to two second-year and three first-year doctoral students. Making the infrastructure of JRET available for the students of the Doctoral School. Involving doctoral students in the implementation of specific projects. Involving graduate students in the research. Presentations organized for students in order to present the activities of several industrial companies. In order to promote research mobility, we support our colleagues' involvement as experts into our corporate partners' operative activities, thereby ensuring opportunities of corporate practice for our researchers.

## RESULTS

JRET has elaborated three new research topics, which PhD students can work on either as an individual doctoral topic. The subject called "The simulation of metal forming processes" is already taught during two semesters. The subject entitled "Alternative-drive vehicles" has been started as an elective course taught in English. We have continuously been involving students in the activity of the Knowledge Center; their average headcount is 10 persons. The graduate students on research placement have successfully completed their individual work related to the research projects. In connection with the research activities of JRET 19 final theses were generated altogether, of which 11 were linked to university projects while 8 were primarily linked to corporate research activities.

## FUTURE TASKS

To broaden the scope of collaboration with the Doctoral School, through the launch of common doctoral topics by the companies and the university. Within the accredited "MSc in Mechatronic Engineering" and an accreditated "MSc in Automotive Engineering" to be launched, the aim is to get the students know about the modern measurement processes and instruments, to start the Industrial Mathematics major under preparation and to elaborate proposals for final theses. To transfer the publishable results generated by the research projects into undergraduate education. To expand student activity and to supplement it with even more individual assignments. To further support self-motivated student groups in the preparation for the competition called the "Széchenyi Run".

# III/2: Activities supporting R&D tasks (Technology transfer, demonstration activities)

Project leader: Péter Tamás Szilasi (SZE-JRET)
Sub-project leader: Ildikó Kóbor (SZE-JRET)

## OVERVIEW

The project includes four activities belonging to the topic of technology transfer in the wider sense. The first activity supports the utilization of the research results and the knowledge and information flow. The second key task is to evolve and enhance the relations among the region's economic players and the third is to participate in the elaboration of the development concepts in connection with the city and the region. The fourth activity is to realize the corporate research initiated by JRET through the University's departments, relying partly on the intellectual capacity of JRET. The main exploiters of this activity are the companies in the vehicle industry. All these contribute together to enhancing the region's competitiveness and to attracting new activities of high value added.




## ACTIVITIES COMPLETED

Two double issues of the periodical called "The vehicle of the future" – founded together with the Knowledge Center of the Budapest University of Technology and Economics (EJJT) – were published in the past year; the next issue is bound to appear at the end of this year. The periodical is disseminated to each of our interested partners, enterprises and professional organizations alike. The Knowledge Center staff continuously publishes their research results in different specialist journals and in the framework of domestic and international conferences and professional events. We signed an agreement of cooperation with the Hungarian Patent Office, in terms whereof we established the Győr branch of the intellectual property right protection advisory center under the name "PatLib". Two employees of the Knowledge Center currently attend high-level industrial property protection training. We joined several international research projects, participated in the elaboration and preparation of the projects. We further developed the homepage of the Knowledge Center (www.jret.sze.hu) and the English version has been prepared as well. The Newsletter published biweekly by the Knowledge Center is disseminated in electronic form to a wide range of enterprises and professionals. We participated as co-organizers at the ID-DRG world conference on sheet shaping, held this year in Győr. We also organized the conference and professional exhibition on vehicle manufacturing technology entitled **Tech4Auto 2007** in the framework whereof we presented the results of our corporate research cooperation projects and by inviting well-known government officials and experts, we introduced the Autopolis development strategy in detail. The Knowledge Center continues to actively participate in elaborating and implementing the conception of the AUTOPOLIS West-Hungarian Development Pole and of the University's development plans in connection with it. In the framework of the corporate R&D activity mentioned as the fourth element, the activity of JRET has generated new interdisciplinary research projects of more and more significant complexity.

## RESULTS

The news of the Knowledge Center and that of the research and development activity of Széchenyi István University, moreover the information and new developments on the available technological capacity and the related services regularly reach some 650 addressees. We published several scientific articles in special periodicals and we disseminated our research results within the framework of presentations delivered at multiple well-known domestic and international events attended by a prestigious circle of professionals. We established the PatLib intellectual right protection advisory office. In cooperation with European partner institutions, we took part in several international projects (7th R&D Framework Program, Centrope research and development network, bilateral key project), which have reached the phase of tender submission. At the Tech4Auto **2007** event series we held discussions with 250 professional participants and 32 exhibitors in connection with the future of automotive research and development and about possible cooperation. With the active collaboration of the Knowledge Center, the key projects of the Győr pole were concretized and took final shape. Within these, the economic development motivated development programs of Széchenyi István University to occupy a key role, which also ensures the framework for the further development of the Knowledge Center. The effect of the mentioned activities on the region's economic development and on the strengthening of the innovation activity can only be measured after several years. The numerically measurable result of the technology transfer is the university research activity worth HUF 143 million – generated by the activity of JRET – carried out for the region's automotive end product manufacturers and suppliers, as well as its effect on the companies' activities in the field of increasing efficiency and quality improvement.

## FUTURE TASKS

The technology transfer activity is a continuous task, which means further maintaining the created periodical, annually organizing the conferences and exhibitions, carrying on and expanding the publication activities, participating in the elaboration of the region's development concepts as well as the all more powerful expansion of corporate research. As a key task, the Knowledge Center continuously supports the implementation process of the AUTOPOLIS project with technological and construction knowledge as well as with human resource development. The Knowledge Center staff will actively participate in the elaboration and implementation of the tenders expected to be published in the following year.


AUTOPOLIS
Nyugat-Magyarországi Fejlesztési Pólus
"A fejlődés vonzásában"



Tech4Auto

# Cooperation with the industrial partners, technology transfer

The rate of cooperation with the industrial partners is included in the tender work plan of the individual projects. In this report, the participating persons represent the common work of the consortium partners. As a result of the research work carried out together, the following important progress has been experienced with respect to the corporate and university R&D&I activities:

- A stable relationship of partnership has evolved among the companies and the university
- The common research activity has substantially increased the activeness of corporate research
- The university's lecturers and researchers became active members of the research market
- The complex nature of the research projects stimulated the close collaboration between the university's and the corporate research teams – the common application of theory and practice when completing the tasks.

The most important consequence of these main statements is that each party acquired something positive from the other partner. The corporate staff received dynamic motivation for the research activity; as a result they regarded their participation in the project as an honor and took a very active part in it. So it was also due to this positive attitude that the management of the partner companies considerably increased the research and development staff. The research activity of the university lecturers has grown to a similarly significant extent as well.

The multiplicative effect of the JRET projects can also be observed in the short run as at the companies, their successful completion reinforced the R&D elements in the case of out-of-project activities as well. In the same way, the demand has arisen to participate in new tenders and to expand the research activity.

The technology transfer activity is defined as a separate sub-project and its results are presented by item III/1-2. Similarly the results of the individual projects are included in the report. It can be regarded as an outstanding result that Rába Axle Ltd intends to nominate the new construction created as a result of the special axle construction development presented in part task II/3 for the next Grand Prix of Innovation.

The managers of the project activity and the leaders of the individual projects are shown in the following table.

| Determinant person | Consortium member | Time spent on the project | Function |
|---|---|---|---|
| Dr. Imre Czinege | SZE (1) | 30% | President, Steering Committee |
| Dr. Tamás Réti | SZE (1) | 20% | President, Scientific Committee |
| Dr. Károly Kardos | SZE (1) | 20% | Leader, R&D program I. |
| Dr. Károly Szőcs | RÁBA (2) | 20% | Leader, R&D program II |
| Péter Tamás Szilasi | SZE (1) | 100% | Leader, R&D program III |
| Szabolcs Horváth | BORSODI (3) | 20% | Consortium member, project leader |
| Zoltán Ódor | SAPU (4) | 30% | Consortium member, project leader |
| Dr. Ernő Halbritter | SZE (1) | 30% | Research project leader |
| Dr. Gábor Dogossy | SZE (1) | 90% | Research project leader |
| János Jósvai | SZE (1) | 50% | Research project leader |
| Imre Herczeg | RÁBA (2) | 30% | Research project leader |
| Dr. Ernő Fülöp | RÁBA (2) | 20% | Consortium member, project leader |
| Dr. Zoltán Horváth | SZE (1) | 50% | Research project leader |
| Mátyás Andrási | RÁBA (2) | 30% | Research project leader |
| Kálmán Rákóczy | RÁBA | 30% | Research project leader |
| Dr. Zoltán Varga | SZE (1) | 30% | Research project leader |
| Csaba Tóth-Nagy | SZE (1) | 50% | Research project leader |

# Publications

**1. R&D program no. 1: Research on the manufacturing technology and tools of highly complex, high-quality components for the vehicle industry**


1. Dr. Ernő Halbritter – Dr. Miklós Tisza – Ferenc Tancsics: Examination of fibre placation problems at volume shaping with finite element method, The Vehicle of the Future, 2006/3–4, p. 41–43.
2. Ernő Halbritter: Limited optimization using the Mathcad and Pro/Engineer software, accepted electronic publication, UNITIS, 11 pages
3. Ernő Halbritter: Multi-variant optimization problem with a constraint using the Pro Engineer software, ISSN 1454 – 0746 Technical Review – XV: OGÉT 2007. Cluj Napoca (Romania), 38/2007, pp.: 135–139.
4. Ernő Halbritter, István Kozma: Minimization possibilities of the total length of bars in four-jointed mechanism planning by using the Pro Engineer software – ISSN 1454 – 0746 – Technical Review – XV: OGÉT 2007. Cluj Napoca (Romania), 38/2007, pp.: 139–143.
5. Miklós Ács - Ferenc Tancsics: Making models suitable for processing in SUPERFORGE, research report, RÁBA 2006
6. Zsuzsanna Körmendi – Ferenc Tancsics: SUPERFORGE user's manual – Basics, Rába 2007
7. Dr. Imre Czinege: Development of a complex sheet metal testing technique in Széchenyi István University, The Vehicle of the Future, 2006/3–4, p. 20–23.
8. Dr. Levente Solecki, Dr. Béla Palásti-Kovacs, Barnabás Kiss: Untersuchung der Topologie von Oberflächen nach dem Laser-Honen, The Vehicle of the Future, 2006/3–4, p. 34–37.
9. Dr.-Ing. Stefan Wagner, Prof. Dr.-Ing. Mathias Liewald MBA: Leichtbaukonzepte für PKW kleiner Gesamtstückzahlen, The Vehicle of the Future, 2006/3–4, p. 16–18.
10. Dirk Behring, Oliver Erne, Mladen Gomercic: Optische 3D-Messtechnik als Ersatz für konventionelle Weg- und Beschleunigungssensorik, The Vehicle of the Future, 2006/3–4, p. 27–29.
11. István Kozma: Industrial application of the optical measurement systems of the Material Science and Vehicle Manufacturing Department, The Vehicle of the Future, 2006/3–4, p. 24–26.
12. Dr. habil. Károly Kardos, Dr. Mária Kirchfeld, J.H Souza: Wear testing of small-series sheet metal shaping tools, The Vehicle of the Future, 2006/3–4, p. 30–33.
13. T. Kovács, L. Solecki, I. Barta, B. Borossay: The relationship between local wear and the texture structure in the case of different structural steels. In: Bitay E. (ed.) Technical Scientific Papers: 12th Scientific Conference for Young Engineers, Cluj Napoca (Romania), Múzeum Association of Transylvania, 2007. p. 125–132.
14. M. Kirchfeld, K. Kardos: Wear-Test of Sheet-Metal Forming Dies of Polymer Composites, Technical Review, Cluj Napoca (Romania), 38/2007, 189–196 old.
15. K. Kardos, M. Kirchfeld, J.H.C. de Souza, S. Wagner, M. Liewald: Applicability of Casting Resin Tools in Sheet Metal Forming, IFU-Stuttgart, SZE-Győr, 2007, ISBN 978 963 06 23049
16. Gábor Dogossy: The possibility of applying re-granulates in the vehicle industry, The Vehicle of the Future, 2006/3–4, p. 38–40.
17. Prof. Dr.-Ing. Egon Müller: Anwendung von Methoden und Werkzeugen der Digitalen Fabrik im Fahrzeugbau, The Vehicle of the Future, 2006/3–4, p. 44–45.
18. Dr. Károly Kardos, János Jósvai, Zoltán Békési: Application of the manufacturing process simulation in small-series production based on a practical example, The Vehicle of the Future, 2006/3–4, p. 46–47.
19. K. Böröcky, T. Réti, G. Wintsche: On the combinatorial characterization of quasi-crystals, Journal of Geometry and Physics, Vol. 57, (2006) p. 39–52.
20. M. Réger, T. Kovács, T. Réti: Analyzing heat technical processes at local wear testing, In: E. Bitay (ed.) Technical Scientific Papers: 12th Scientific Conference for Young Engineers, Cluj Napoca (Romania), Múzeum Association of Transylvania, 2007. p. 153–156.
21. E Bitay, T. Réti: Topological description of 3D periodical cell systems. In: E. Bitay (ed.) Technical Scientific Papers: 12th Scientific Conference for Young Engineers, Cluj Napoca (Romania), Múzeum Association of Transylvania, 2007. p. 31–48.
22. T. Réti, E. Bitay: Prediction of fullerene stability using topological descriptors, Materials Science Forum, Vols. 537–538, (2007) p. 439–448.
23. T Réti., A. Csizmazia, I. Felde: On the topological characterization of 3-D polyhedral microstructures, Materials Science Forum, Vols. 537–538, (2007) p. 563–570
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25. T. Reti, I. Zsoldos: Simulation of 3-dimensional cell population growth processes in polyhedral cellular structures, Materials Science Forum, Vols. 537–538, (2007) p. 579–590.
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27. I. Felde, I. Czinege, B. Smoljan, R. Colas: A novel approach of quenchant evaluation by applying quality functions, Materials Science Forum, Vols. 537–538, (2007) p. 513–518.

**II. R&D program no. II: Developing modern vehicle main units and researching their diagnostic methods**

1. Zoltán Horváth: CAD-FEM integration and its application for developing vehicle main units, The Vehicle of the Future, 2007/1–2, p. 68–70.
2. János D. Pintér: Global Optimization: Application Perspectives in Engineering Design, The Vehicle of the Future, 2007/1–2, p. 71–75.
3. Z. Horváth, T. Morauszki, K. Tóth: Automated CAD-based CFD-Optimization and Applications in Diesel Engine Design – In: M. Jirka, Weber (eds.): CD-ROM Proceedings of 3rd European Automotive CFD Conference, Frankfurt, July 5–6, 2007.
4. Z. Horváth, T. Morauszki, K. Tóth: CAD-based Optimization and Applications in Automotive Engineering - In: Zupancic, Karba, Blazic (eds.): Proceedings of 6th EUROSIM Congress on Modeling and Simulation, September 9–13, 2007, Ljubljana, Slovenia. ISBN-13: 978-3-901608-32-2

   ***NB:*** *the article was chosen among the best 30 out of the 420 presentations delivered at the conference. Out of these 30, some 15 will be asked to be further processed in January in order to be published in a prestigious periodical – there is a good opportunity for this to happen.*
5. Dr. István Faragó, Dr. György Inzelt, Ákos Kriston, Miklós Kornyik, Tamás Szabó: Fuel development from a Hungarian perspective, The Vehicle of the Future, 2007/1–2, p. 62–65.



# Final Theses

**I. R&D program no. I: Research on the manufacturing technology and tools of highly complex, high-quality components for the vehicle industry**

1. Tamás Gergye: Constructional and production technological design of flanged stud pre-products
2. Sándor Ollé: Analyzing and modeling in-plant material processes using the Tecnomatix Plant Simulation 7.6 software
3. Réka Wágner: Arrangement of the manual assembly line of a mass-manufactured product, installation of the workstations and designing and implementing the material flow
4. Balázs Tóth: Optimizing production by searching for constructional and assembly technique solutions
5. András Szabó: Perfecting products and manufacturing processes with respect to developing the early production capabilities and the currently existing European program
6. Péter Győri: Solving blank definition and optimization tasks in the case of certain deep-drawn work-pieces using Pro Engineer software
7. László Varga: The application specificities of water-jet cutting technology
8. Balázs Bogdány: Cutting sheet metal with water
9. Imre Csapó: Producing small-series cutting tools by using water-jet cutting
10. Péter Albert: Analyzing tolerance in the case of outdoor rearview mirrors
11. Tamás Nyerges: Replacing cast metal components by technical polymers in the production of rearview mirrors.
12. Bálint Borsodi: Analyzing the production process and defining the bottle-neck in complex product manufacturing in the interest of decreasing processing times
13. Attila Tuller: Elaborating, implementing and analyzing the in-production and end-testing measurement process of custom-manufactured machine components at Borsodi Műhely Ltd.
14. Szabolcs Horváth: Innovation management at Borsodi Műhely Ltd., 2007.

**II. R&D program no. II: Developing modern vehicle main units and researching their diagnostic methods**

1. Ádám Zoltán Fejes: Optimizing the shape of outdoor rearview mirrors
2. Péter Tamás Závori: Examining the flow of air around rearview mirrors
3. Zoltán Szabó: Designing a strengthened retarder holder for the E13 midibus for applying a TELMA FOCAL 90 type retarder.
4. Tibor Szabó: Examining the axle of the Claas Xerion 3003 high-speed power machine

**III. R&D program no. III: Technology and knowledge transfer**

1. János Barits: The phases of development of the R&D activity at the Hungarian automotive suppliers

# Scientific Student Conference papers

1. Tamás Gergye: Examples for problem solving in the case of multiple-impression die forging. 28th National Scientific Student Conference, Technical Science Section, Malleable Shaping and Metallurgical Technologies Branch, Győr, April 2–4, 2007

# Events, Presentations

1. March 7, 2007: Dr. Imre Czinege, Mrs. Ferenc Csizmazia dr.: Digital optical measurements in material testing, 5th Conference on Material Testing without Destruction, 2007
2. Czinege, I.: Integrated Design Process for Sheet Metal Forming. International Deep-drawing Research Group IDDRG 2007 International Conference, 21–23 May 2007, Győr-Hungary.
3. M. Kirchfeld, K. Kardos, J.H.C. de Souza, S. Wagner, M. Liewald: Applicability of Polymeric Materials for Rapid-tooling in Sheet Metal Forming, Proceedings of IDDRG International Conference, Győr, Hungary, 2007, 445–452 old.
4. János Jósvai: Simulation and production planning, A special case in short series production, Eurosim2007 Conference, Ljubljana, September 9–14, 2007
5. September 9–14, 2007: Ljubljana, Organization of a special section at the Eurosim2007 conference, Title: TU-3-P12: DIGITAL FACTORY/SIMULATION AND OPTIMIZATION OF INDUSTRIAL PROCESSES (S07) www.eurosim2007.org
6. September 20, 2007: Dr. Károly Kardos, Péter Tamás Szilasi: Integrated program aimed at knowledge-based economic development at Széchenyi István University, Regional Research and Development Conference and Vehicle Manufacturing Technology Exhibition, Győr
7. September 20, 2007: Mátyás Andrási, Kálmán Rákóczy: Increasing the capacity of one-phase driven axles by applying modern development methods, Regional Research and Development Conference and Vehicle Manufacturing Technology Exhibition, Győr
8. September 20, 2007: Zoltán Ódor, Zoltán Kocziha, Dr. Gábor Dogossy, Tamás Morauszki: Applying glass fiber polymer material instead of aluminum in the case of mirror holder cases, Regional Research and Development Conference and Vehicle Manufacturing Technology Exhibition, Győr
9. September 20, 2007: Szabolcs Horváth, Mrs. Ferenc Csizmazia dr.: Developing aircraft component technologies, Regional Research and Development Conference and Vehicle Manufacturing Technology Exhibition, Győr
10. September 20, 2007: Attila Herk, Attila Buczkó, Krisztián Tóth: Application of simulation techniques for sheet metal and polymer shaping technologies, Regional Research and Development Conference and Vehicle Manufacturing Technology Exhibition, Győr
11. June 11–15, 2007: G. Dogossy, T. Czigány: Biodegradable composites from starch reinforced by agricultural byproducts, 3rd China-Europe Symposium on processing and properties of reinforced polymers, Budapest
12. May 31 – June 1, 2007: G. Dogossy, Z. Ódor, G. Ferencz: JRET-SAPU project results of painted polymer housing of automobile rearview mirror, EAEC 2007 11th European automotive congress, Budapest
13. October 24–26, 2007: G. Dogossy, Z. Ódor, Z. Kocziha: Material change of a mirror frame JRET-SAPU project result, K-2007, Düsseldorf
14. September 20, 2007: Levente Tibori, Dr. Ottó Klementis, Dr. Zoltán Horváth: Simulation of flow processes in the case of personal vehicle rearview mirrors, Regional Research and Development Conference and Vehicle Manufacturing Technology Exhibition, Győr
15. March 26–28, 2007: J. D. Pintér: Course on Global Optimization – Models, Algorithms, Software, and Applications Széchenyi István University, Győr
16. June 7–9, 2007: Zoltán Horváth: Determining the production preciseness of components through global optimization, Conference of the Hungarian Association for Operations Research, Balatonőszöd
17. June 20, 2007: Zoltán Horváth: Automated, integrated CAD-based development system, CFD Workshop, MTA Hydrodynamic and Thermal Technology Committee, Sub-Committee of Numerical Hydrodynamics, Budapest, BME
18. July 5–6, 2007: Z. Horváth, T. Morauszki, K. Tóth: Automated CAD-based CFD-Optimization and Applications in Diesel Engine Design, 3rd European Automotive CFD Conference, Frankfurt
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20. A. Opitz, Tyler: All the wheel drive trends and challenges for heavy trucks and vehicles.
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21. December 6, 2006: Meeting with West-Transdanubian businessmen - "Business on the move in West-Transdanubia", Péter Tamás Szilasi, Brussels
22. April 2, 2007: Péter Tamás Szilasi: Regional University Knowledge Center for Vehicle Industry; Vision and goals, introduction of the operation based on the results achieved in 2006; West-Transdanubian Higher Education Forum, Győr
23. April 4, 2007: Péter Tamás Szilasi: A University based technology-transfer program to support the development of Autopolis Innovation Network; CORINNA Expert Group Meeting, Interreg IIIC Project „CORINNA"; Klagenfurt, Austria
24. June 11–12, 2007: Participation at the INNO-Forum Poster Exhibition
25. June 13, 2007, Péter Tamás Szilasi: The AUTOPOLIS vision and the place of Széchenyi István University in the development program of the automotive region; AKJ Automotive Hungary Conference; Győr

# Media Appearances

1. Marketing the research activity – Tuned into something else, Weekly World Economy, Volume XXVIII.
2. University and corporate cooperation – For efficient manufacturing in the vehicle industry, Economic Mirror Magazine, 2007, Volume VII.
3. Students involved in projects – Knowledge Center, Győr Week, 2007, Volume III.
4. Modern research and development at the Széchenyi István University in Győr, Hungarian Newspaper, July 6, 2007
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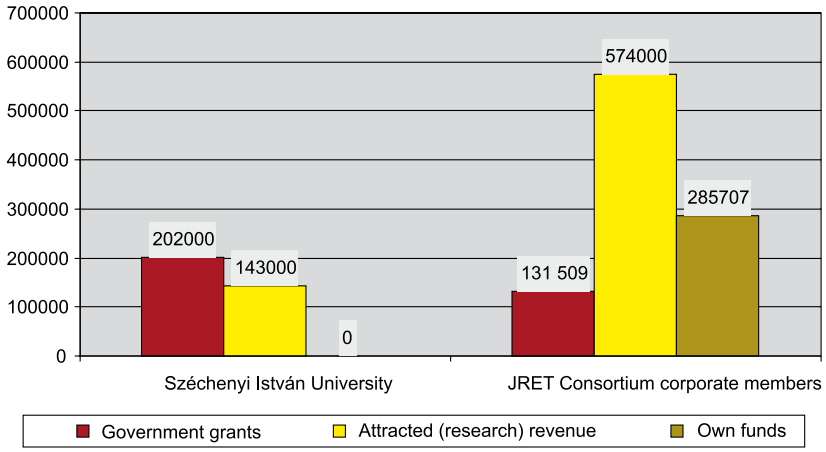
# Main financial indicies, summary tables

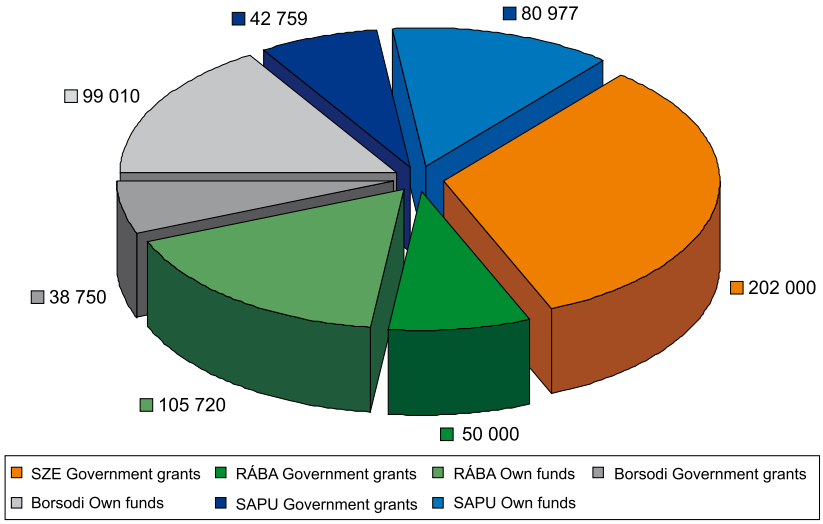
## THE DEVELOPMENT OF PERFORMANCE INDICATORS

| Result | Fact | Plan |
|---|---|---|
| The exploitable result of the project | | |
| Kifejlesztett új* | | |
| products (piece) | 24 | 20 |
| services (piece) | 3 | 3 |
| technologies (piece) | 1 | 1 |
| applications (piece) | 3 | 3 |
| prototypes (piece) | 25 | 26 |
| Scientific results | | |
| Publications (including presentations) | | |
| Domestic (piece) | 63 | 14 |
| International (piece) | 26 | 7 |
| Human resources | | |
| Are the project results utilized in education/training? (Y/N), in what form? | Yes | Yes |
| Number of persons involved in the project | | |
| university students (person) | 14 | 11 |
| PhD students (person) | 3 | 5 |
| young researchers (person) | 1 | 6 |
| Number of researchers having gained a scientific degree due to the project (person) | 1 | 0 |
| Number of workplaces created due to the project | | |
| at enterprises (piece) | 5 | 4 |
| at research entities (piece) | 2 | 1 |
| Out of this: researcher workplace (piece) | 4 | 3 |
| (Note: in full-time equivalence) | 3,7 | |
| Economic utilization | | |
| Number of participating entities in the center's activities | | |
| number of research entities (piece) | 3 | 3 |
| number of enterprises (piece) | 8 | 3 |
| Number of firms utilizing the results (piece), contact data | 5 | 8-10 |
| Financial results achieved as the result of the project | | |
| Surplus revenue (HUF) | 717 million | 35 million |
| out of this, export revenue (HUF) | 554 million | 15 million |
| Cost reduction (HUF) | 32 million | 150 million |

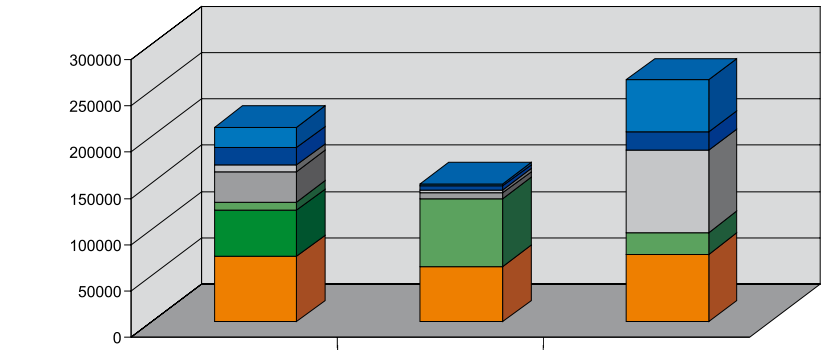
Financing structure of the Regional University Knowledge Center (2007)




JRET tender cost distribution by project partner (HUF thousand), research year 2007

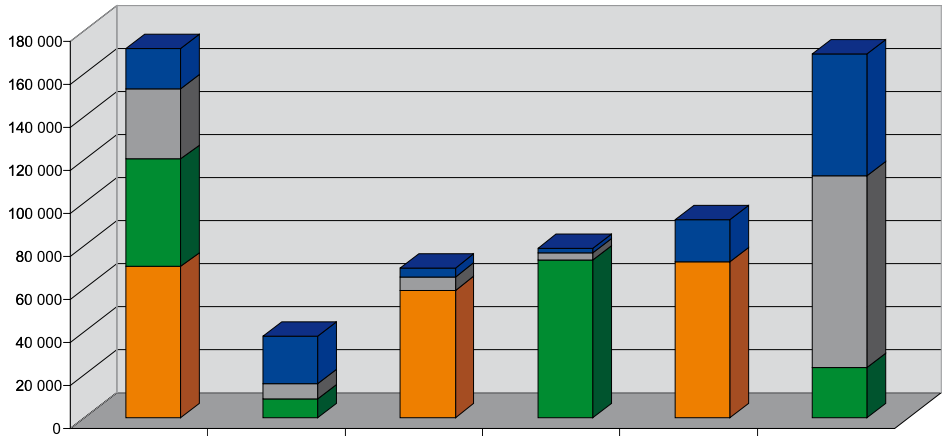



Utilization of the project partners' resources by cost types (HUF thousand), research year 2007



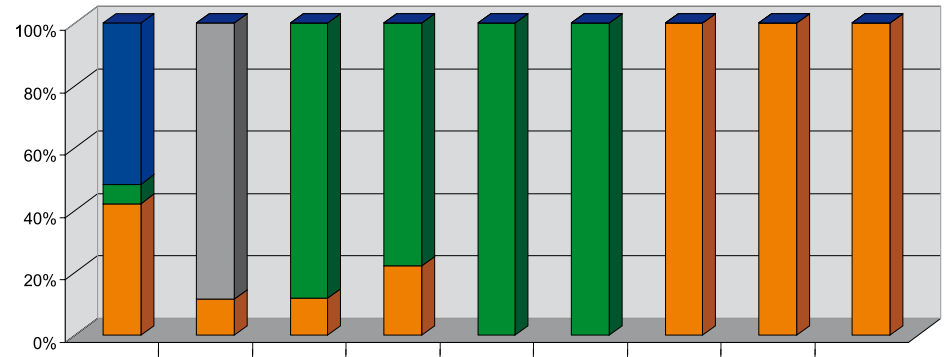

| | Personal | Material | Investment |
|---|---|---|---|
| SAPU - Own funds | 22176 | 2196 | 56605 |
| SAPU - Government grants | 19083 | 4200 | 19476 |
| Borsodi - Own funds | 6930 | 3127 | 88953 |
| Borsodi - Government grants | 32500 | 6250 | 0 |
| Rába - Own funds | 8932 | 73412 | 23376 |
| Rába - Government grants | 50000 | 0 | 0 |
| SZE - Own funds | 0 | 0 | 0 |
| SZE - Government grants | 70200 | 59300 | 72500 |

Utilization of the project partners' resources by cost types (HUF thousand), research year 2007



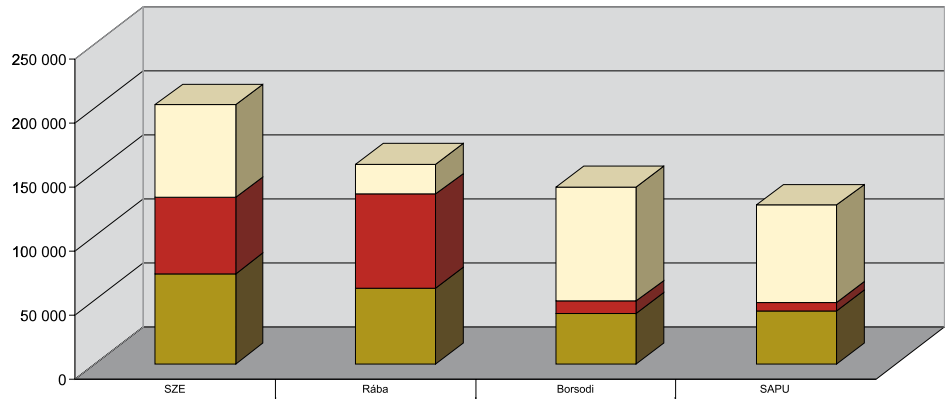

| | Personal Government grants | Personal Own funds | Material Government grants | Material Own funds | Investment Government grants | Investment Own funds |
|---|---|---|---|---|---|---|
| SAPU | 19 083 | 22 176 | 4 200 | 2 196 | 19 476 | 56 605 |
| Borsodi | 32 500 | 6 930 | 6 250 | 3 127 | 0 | 88 953 |
| Rába | 50 000 | 8 932 | 0 | 73 412 | 0 | 23 376 |
| SZE | 70 200 | 0 | 59 300 | 0 | 72 500 | 0 |

Research year 2007 – The proportion of the JRET consortium partners' participation in the individual research projects (in %)




| | I.1 | I.2 | I.3 | II.1 | II.2 | II.3 | II.4 | III. 1 and III.2 | Management |
|---|---|---|---|---|---|---|---|---|---|
| SAPU | 123736 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Borsodi | 0 | 137760 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rába | 14713 | 0 | 26634 | 25463 | 27033 | 61877 | 0 | 0 | 0 |
| SZE | 101000 | 17950 | 3550 | 7250 | 0 | 0 | 5600 | 27400 | 39250 |

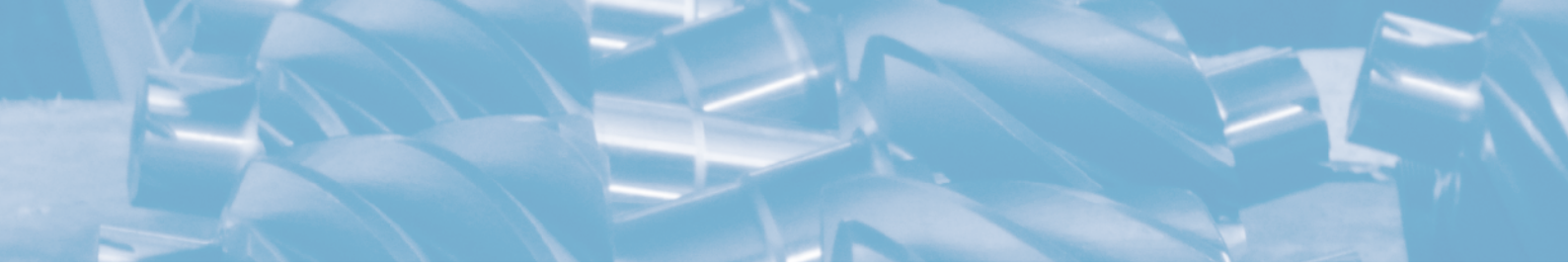
Project cost distribution by project partner (HUF thousand), Research year 2007




| | SZE | Rába | Borsodi | SAPU |
|---|---|---|---|---|
| Investment | 72 500 | 23 376 | 88 953 | 76 081 |
| Material | 59 300 | 73 412 | 9 377 | 6 396 |
| Personal | 70 200 | 58 932 | 39 430 | 41 259 |

# R&D STAFF AND TIME SPENT ON THE PROJECT

| Person | Consortium member | Sub-project number | Time spent on the project (day) | Time spent on the project (%) | Function |
|---|---|---|---|---|---|
| Dr. Imre Czinege | SZE (1) | I/1. | 54 | 30% | President, Steering Committee |
| Dr. Tamás Réti | SZE (1) | I/3. | 36 | 20% | President, Scientific Committee |
| Dr. Ernő Halbritter | SZE (1) | I/1. | 54 | 30% | Research project leader |
| Dr. Károly Kardos | SZE (1) | I/1. | 36 | 20% | Leader, R&D program I. |
| Dr. Gábor Dogossy | SZE (1) | I/1. | 162 | 90% | Research project leader |
| Ágnes Böröcz | SZE (1) | I/1. | 180 | 100% | Researcher |
| Attila Buczkó | SZE (1) | I/1. | 180 | 100% | Researcher |
| Zoltán Kocsárdi | SZE (1) | I/1. | 180 | 100% | Researcher |
| Iván Tarcsay | SZE (1) | I/1. | 54 | 30% | R&D supporting staff |
| Márta Bognárné Pápai | SZE (1) | I/1. | 27 | 15% | R&D supporting staff |
| Dr. Mária Kirchfeld | SZE (1) | I/1. | 36 | 20% | Researcher |
| Andrásné Kobrizsa | SZE (1) | I/1. | 27 | 15% | R&D supporting staff |
| István Kozma | SZE (1) | I/1. | 54 | 30% | R&D supporting staff |
| László Varga | SZE (1) | I/1. | 54 | 30% | R&D supporting staff |
| János Jósvai | SZE (1) | I/2. | 90 | 50% | Research project leader |
| Sándor Ollé | SZE (1) | I/2. | 27 | 15% | Researcher |
| Gábor Pápai | SZE (1) | I/2. | 27 | 15% | R&D supporting staff |
| Dr. József Pintér | SZE (1) | I/2. | 27 | 15% | Researcher |
| Dr. Levente Solecki | SZE (1) | I/2. | 45 | 25% | Researcher |
| Zoltán Vass | SZE (1) | I/2. | 27 | 15% | R&D supporting staff |
| Ferencné Csizmazia dr. | SZE (1) | I/3. | 45 | 25% | Researcher |
| Dr. Zoltán Horváth | SZE (1) | II/1. | 90 | 50% | Research project leader |
| Tamás Morauszki | SZE (1) | II/1. | 180 | 100% | Researcher |
| Krisztián Tóth | SZE (1) | I/1. II/1. | 180 | 100% | Researcher |
| Dr. Péter Horváth | SZE (1) | II/1. | 54 | 30% | Researcher |
| Attila Nagy | SZE (1) | II/1. | 27 | 15% | Researcher |
| Tibor Menyhárt | SZE (1) | II/1. | 18 | 10% | Researcher |
| Péter Bauer | SZE (1) | II/1. | 18 | 10% | Researcher |
| Dr. Zoltán Varga | SZE (1) | II/2. II/3. II/4. | 54 | 30% | Research project leader |
| Péter Beke | SZE (1) | II/2. II/3. | 27 | 15% | Researcher |
| Ferenc Szauter | SZE (1) | II/2. II/3. | 27 | 15% | Researcher |
| Dr. Csaba Tóth Nagy | SZE (1) | II/4. | 54 | 30% | Researcher |
| Tamás Péter Szilasi | SZE (1) | III/1. III/2. | 180 | 100% | Leader, R&D program III. |
| Dr. Károly Szőcs | RÁBA (2) | I/1. I/3. II/1. II/2. II/3. | 36 | 20% | Leader, R&D program II. |
| Dr. Ernő Fülöp | RÁBA (2) | II/1. II/3. | 108 | 60% | Consortium member, project leader |
| Imre Herczeg | RÁBA (2) | II/1. | 54 | 30% | Research project leader |
| Mátyás Andrási | RÁBA (2) | II/2. II/3. | 108 | 60% | Research project leader, researcher |
| Kálmán Rákóczy | RÁBA (2) | II/3. II/1. | 108 | 60% | Research project leader, researcher |
| Zoltán Bognár | RÁBA (2) | II/3. | 54 | 30% | Researcher |
| László Varga | RÁBA (2) | II/1. | 54 | 30% | Researcher |
| Gábor Iváncza | RÁBA (2) | II/2. | 54 | 30% | Researcher |
| Antal Horváth | RÁBA (2) | II/2.; II/3. | 54 | 30% | Researcher |
| László Nagy | RÁBA (2) | II/1. | 36 | 20% | Researcher |
| Imre Szinger | RÁBA (2) | II/1. | 54 | 30% | Researcher |
| Imre Tripolszki | RÁBA (2) | II/2. II/3. | 54 | 30% | Researcher |
| Imre Móczár | RÁBA (2) | II/2. | 54 | 30% | Researcher |
| Jenő Petőfalvi | RÁBA (2) | II/1. II/2. | 54 | 30% | Researcher |
| László Légmán | RÁBA (2) | II/2. | 90 | 50% | Researcher |



| | | | | | |
|---|---|---|---|---|---|
| István Molnár | RÁBA (2) | II/1. II/3. | 54 | 30% | Researcher |
| Miklós Ács | RÁBA (2) | I/1. I/3. | 54 | 30% | Researcher |
| István Csáki | RÁBA (2) | I/1. I/3. | 54 | 30% | Researcher |
| László Simon | RÁBA (2) | II/2. | 54 | 30% | Researcher |
| Ferenc Tancsics | RÁBA (2) | I/1. I/3. II/3. | 108 | 60% | Researcher |
| Attila Polgár | RÁBA (2) | II/1. II/2. | 54 | 30% | Researcher |
| Andor Opitz | RÁBA (2) | II/2. II/3. | 108 | 60% | Researcher |
| Miklós Bavolyár | RÁBA (2) | I/1. I/3. | 54 | 30% | Researcher |
| Zoltán Mészáros | RÁBA (2) | I/1. I/3. | 54 | 30% | R&D supporting staff |
| Szilárd Polgár | RÁBA (2) | II/3. | 36 | 20% | R&D supporting staff |
| Gábor Milkovits | RÁBA (2) | II/3. | 54 | 30% | Researcher |
| Zsuzsanna Körmendi | RÁBA (2) | I/1. | 54 | 30% | Researcher |
| László Tordai | RÁBA (2) | II/3. | 54 | 30% | R&D supporting staff |
| Imréné Kaizinger | RÁBA (2) | II/3. | 54 | 30% | Researcher |
| Lajos Szüts | RÁBA (2) | I/1. I/3. II/1. II/2. II/3. | 36 | 20% | Researcher |
| Katalin Muzsai | RÁBA (2) | II/2. II/3. | 54 | 30% | R&D supporting staff |
| Szabolcs Horváth | BORSODI (3) | I/2. | 144 | 80% | Consortium member, project leader |
| József Bánhalmi | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Márton Barbély | BORSODI (3) | I/2. | 108 | 60% | Researcher |
| Krisztián Bejczi | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| József Borbély | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Péter Borsodi | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Szabolcs Lendvai | BORSODI (3) | I/2. | 54 | 30% | Researcher |
| Endre Ősz | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Győző Csapó | BORSODI (3) | I/2. | 108 | 60% | R&D supporting staff |
| Andrea Gál | BORSODI (3) | I/2. | 63 | 35% | Researcher |
| jun. László Borsodi | BORSODI (3) | I/2. | 63 | 35% | Researcher |
| Károly Jukli | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Ferenc Szabó | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Tamás Lascsik | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Miklós Mezzey | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Róbert Miklós | BORSODI (3) | I/2. | 63 | 35% | R&D supporting staff |
| László Pálfi | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| János Nagy | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Boldizsár Szalay | BORSODI (3) | I/2. | 36 | 20% | Researcher |
| Gábor Ónodi | BORSODI (3) | I/2. | 162 | 90% | Researcher |
| Miklós Pákozdi | BORSODI (3) | I/2. | 90 | 50% | R&D supporting staff |
| Gábor Szabó | BORSODI (3) | I/2. | 144 | 80% | Researcher |
| István Szücs | BORSODI (3) | I/2. | 45 | 25% | Researcher |
| Győző Szabó | BORSODI (3) | I/2. | 63 | 35% | R&D supporting staff |
| János Vámosi | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| István Boross | BORSODI (3) | I/2. | 54 | 30% | R&D supporting staff |
| Zoltán Ódor | SAPU (4) | I/1. | 147 | 80% | Consortium member, project leader |
| Zoltán Kocziha | SAPU (4) | I/1. | 55 | 30% | Researcher |
| Gábor Ferencz | SAPU (4) | I/1. | 56 | 30% | Researcher |
| István Szmolenszki | SAPU (4) | I/1. | 18 | 10% | Researcher |
| Erika Jankó | SAPU (4) | I/1. | 86 | 45% | Researcher |
| Ildikó Susláné Bolyhos | SAPU (4) | I/1. | 132 | 70% | R&D supporting staff |
| Éva Nagy | SAPU (4) | I/1. | 128 | 70% | R&D supporting staff |
| Lajos Tóth | SAPU (4) | I/1. | 128 | 70% | Researcher |
| Róbert Nagy | SAPU (4) | I/1. | 150 | 70% | R&D supporting staff |
| Zoltán Deák | SAPU (4) | I/1. | 143 | 70% | R&D supporting staff |
| Viktor Fekete | SAPU (4) | I/1. | 26 | 30% | Researcher |
| Dr. Ottó Klementis | SAPU (4) | I/1. | 19 | 10% | Researcher |
| Péter Stasztny | SAPU (4) | I/1. | 80 | 45% | Researcher |
| **Total:** | | | **7252** | | |

**Research workforce converted into full work time: 41 (person)**

# Research tools of significant value and high importance, purchased in the framework of the project

| | |
|---|---|
| **Széchenyi István University** | |
| CAD and CAE software (Pro-E, Moldflow, Autoform, Deform, Autodesk Inventor Professional 11, Ansa, Abaqus, Mathcad, Catia V5 Academic Version) | I/1-1 |
| FEA software (Nastran) | I/1-1 |
| Axio Imager A1 Mat microscope with camera | I/1-2 |
| Scanning electronmicroscope | I/1-2 |
| CAM- and PLM-software (PowerInspect, Tecnomatix, Plant Simulation) | I/2-1 |
| CAE- and FEA-software (Star CD, Fluent, HyperWorks, LGO) | II/1-2 |
| **Rába Axle Ltd.** | |
| Developed die forging software | I/1-1 |
| Lubricator system pulverizer unit | I/3 |
| Forming dynamometer to LZK 6300 Maxima pressing machine | I/3 |
| **Borsodi Műhely Ltd.** | |
| CNC machining center for cutting hard processing (HERMLE) | I/2-2 |
| CNC corrosive machine for high precised processing (Fehlmann) | I/2-2 |
| **SAPU Lp.** | |
| F&S Celsius 640 graphic work station (1 piece) | I/1-3 |
| Resil Impactor 25J swing clockwork and accessories | I/1-3 |
| Instron 3366 universal tensile testing machine (3 pieces) | I/1-3 |
| Heatwave climate chamber (3 pieces) | I/1-3 |
| Manual sample incisive with digital micrometer and accessories | I/1-3 |
| HDT 3 Vicat plastic testing machine and accessories | I/1-3 |
| Aboni FMX Hydrotracer hygrometer | I/1-3 |
| Shore S1 digital durometer with probe | I/1-3 |
| Inflammability testing machine MVSS 302 and accessories | I/1-3 |
| Linear Abraser webbing machine and accessories | I/1-3 |
| Testo 650 reference climate instrument and accessories | I/1-3 |
| SF/450/CCT tip. 450 l. automate cyclical corrosion chamber and accessories | I/1-3 |
| Heating furnace 1200 C | I/1-3 |
| GR 200 EC assay balance | I/1-3 |
| P41 water softener cartridge and accessories | I/1-3 |
| OF1202-40MD3 oil free compressor with filter | I/1-3 |
| CLL 1000 tip. EN 60529 No 1000 l. raining chamber | I/1-3 |
| CP 1000 tip. EN 60529 1000 l. powder chamber | I/1-3 |
| 3 ocular metal microscope ME.2665 and accessories | I/1-3 |

# List of abbreviations

| |
|---|
| SZE-JRET – Széchenyi István University, Regional University Knowledge Center for Vehicle Industry |
| IT – Steering Committee |
| TT – Scientific Committee |
| SZE-AJT – Széchenyi István University, Faculty of Engineering Sciences, Institute of Informatics, Electrical and Mechanical Engineering, Department of Materials and Vehicle Manufacturing |
| SZE-MGT – Széchenyi István University, Faculty of Engineering Sciences, Institute of Informatics, Electrical and Mechanical Engineering, Department of Machine Design and Mechanics |
| SZE-KVJ – Széchenyi István University, Faculty of Engineering Sciences, Institute of Informatics, Electrical and Mechanical Engineering, Department of Automotive and Railway Engineering |
| SZE-MSZT – Széchenyi István University, Faculty of Engineering Sciences, Institute of Informatics, Electrical and Mechanical Engineering, Department of Mathematics and Computer Sciences |
| SZE-FKT – Széchenyi István University, Faculty of Engineering Sciences, Institute of Informatics, Electrical and Mechanical Engineering, Department of Physics and Chemistry |
| CAD – Computer Aided Design |
| CAM – Computer Aided Manufacturing |
| CAE – Computer Aided Engineering |
| FEM – Finite Element Methods |
| GID – Gasinnendruck – Gas-assisted (injection molding) |
| TDM – Tool Data Management |
| BMF-BGK – Technical College of Budapest, Bánki Donát Faculty of Mechanical Engineering |
| PVD - Physical Vapor Deposition |
| EJJT – Advanced Vehicle Control Knowledge Center |
| IDDRG – International Deep Drawing Research Group |
| FEA – Finite Element Analysis |

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JRET

REGIONAL UNIVERSITY
KNOWLEDGE CENTER
FOR VEHICLE INDUSTRY
SZÉCHENYI ISTVÁN UNIVERSITY GYŐR

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