STRATEGY DOCUMENT

OF THE PROJECT TÁMOP-4.2.1.B-10/2/KONV-2010-0001

'IMPROVING THE QUALITY OF HIGHER EDUCATION

ON THE BASIS OF THE DEVELOPMENT OF CENTRES OF EXCELLENCE

IN STRATEGIC RESEARCH FIELDS OF THE UNIVERSITY OF MISKOLC'

Prepared by

Dr. Gácsi Zoltán, university professor, professional leader

Dr. Szemmelveisz Tamás, project manager

Human Resource Development Strategy

Jámborné Dr. Róth Erika, director of human resources

Széll Gábor, director general for finance

Infrastructure Development Strategy

Dr. Lukács János, university professor

Utilisation Plan of Scientific Results

Dr. Dobróka Mihály, vice-rector for scientific and international affairs

R&D Strategy

Dr. Deák Csaba, vice-rector for strategy and development

Dr. Bőhm József, associate professor – Centre of Excellence 1

Dr. Mertinger Valéria, associate professor - Centre of Excellence 2

Dr. Mang Béla, university professor- Centre of Excellence 3

Dr. Tisza Miklós, university professor - Centre of Excellence 4

Dr. Madarász Tamás, associate professor, strategic planner

Dr. Palotás Árpád Bence, university professor, infrastructure coordinator

Schupler Helmuth, managing director, Uniflexys Kft

Roneczné Ambrus-Tóth Judit, assistant to the professional leader

Miskolc, 8 November 2011

A projekt az Európai Unió támogatásával, az Európai Szociális Alap társfinanszírozásával valósul meg.

CONTENTS

1 EXECUTIVE SUMMARY

In the present situation, creating a strategy means first of all looking for a way in a continuously changing environment, while continuing to honour the values of the University of Miskolc, and examining the directions it can take in order to strengthen its position and achieve its objectives. Those preparing the strategy have not only formulated the objectives related to the project, but have also undertaken to examine the impacts on the University of the opportunities inherent in the R&D activities based on its four Centres of Excellence and thus facilitate considerable improvement in the position of the University of Miskolc.

Several factors have exerted a strong influence on the preparation of the strategy: the change in the concept of financing higher education institutions in Hungary, the new National Higher Education System outlined in the legal regulations being prepared, and the strengthening competition between the universities, which is shaped jointly by demographic indicators, the geographical distribution of the institutions and the differences in their performance.

Four primary multi-disciplinary research fields where the researchers are expected to produce competitive results have been determined, with the leading roles in the engineering faculties of the University and with the involvement of the faculties of social and natural sciences. The University does not make a secret of its objective that these are to be emblematic research topics which represent the scientific activities pursued at the University of Miskolc. These fields are:

1. Sustainable natural resource management,
2. Applied materials science and nano-technology,
3. Mechatronics and logistics,
4. Innovative engineering design and technologies.

The strategy presents the development concepts of the four Centres of Excellence established in the priority research fields of the University of Miskolc. The tasks are determined by the commitment of the leadership of the University to the goals that the institution should gain a place among the foremost higher education institutions of Hungary

and that the image of the University of Miskolc and its participation in scientific life should improve also in an international context.

Scientific Workshops have been established within the scientific fields of the Centres of Excellence and research work has begun that is demanding in scientific terms, while at the same time having an industrial background. Within a period of two years we need to demonstrate which of the R&D activities and research groups started will be of strategic importance for the University, as well as be able to continue operation in a self-supporting way and to offer competitive knowledge and services in an international sphere.

There is every hope that the objectives formulated in the strategy documents will further the development of the Centres of Excellence and promote the progress of the University of Miskolc.

* * *

This document has been compiled on the basis of the background materials prepared by those responsible for one portion of the entire strategic plan.

2 THE TASK UNDERTAKEN IN THE PROJECT

In 2010, the University of Miskolc submitted a successful application for the invitation of the project construction TÁMOP-4.2.1.B-10/2-KONV. In the project TÁMOP-4.2.1.B-10/2/KONV-2010-0001 'IMPROVING THE QUALITY OF HIGHER EDUCATION ON THE BASIS OF THE DEVELOPMENT OF CENTRES OF EXCELLENCE IN THE STRATEGIC RESEARCH FIELDS OF THE UNIVERSITY OF MISKOLC', the institution undertook to prepare a **strategy document on research and development concerning the priority research fields of the University.** This document is a short, summarised version of the strategy documents prepared.

2.1 Motivation and the conditions for preparing the strategy

Preparing a strategy is a **contractual obligation** of the University of Miskolc, which is set out in the invitation for applications and the contract for support. Beyond the contractual obligation, the leadership of the project and of the University has come to recognise that the preparation of such a document is of decisive importance also for the future of the University. Beyond the 'obligation of creating a strategy' generated by the invitation for applications, other processes that gained in strength in 2010/2011 have also exerted their influence on the process of strategic direction. The most important are as follows:

a) High-ranking universities in Hungary had the first opportunity in the first quarter of 2010 to apply for the prestigious title '*research university*'. As a result of its application, the University of Miskolc was awarded the title '*excellent University*'. In addition to the application for the title, in the framework of the EU-financed Social Renewal Operational Programme (TÁMOP), the University submitted an application in the summer of 2010 for the invitation of TÁMOP 4.2.1/B-10/2/KONV, where its2.2 billion HUF budget project was awarded 95% intensity funding for supporting the R&D activities of the fields of strategic importance organised into four Centres of Excellence. At the same time, for the period 2011-2013 the institution won further funding of 1.25 billion HUF for infrastructure development (TIOP 1.3.1-10/1) and 500 million HUF for the purpose of care for talented students (TÁMOP 4.2.2-B-10/1). The University intends to use the funding for the winning applications in a harmonised manner in order to improve its competitiveness.

> The Minister for National Resources awarded the titles of *'research elite university*' and *'excellent university'* to five universities each on 16 April 2010. The title of research elite university was awarded to Semmelweis University, the University of Szeged, the University of Debrecen, Eötvös Loránd University, and the Budapest University of Technology and Economics. In addition, the title **'excellent university'** was awarded to the University of Pécs, Szent István University, **the University of Miskolc,** Corvinus University and the University of Pannonia.

b) The **creation of the strategy coincided with the period of the preparation of the new Act on Higher Education.** The new act is expected to result in considerable changes in the operation conditions of higher education institutions in Hungary, which will confront the University of Miskolc with new requirements. The new high-

er education environment aimed at by the act has exerted a significant effect on the preparation of the strategy, which will be discussed in detail later.

c) As a result of the difficulties faced by the University of Miskolc in the sustainability of its financing, the **Senate** of the institution ordered in its **decision 41/2011 of the session of 24 March 2011** that "*the vice-rector for strategy and development shall submit a proposal to the Senate for an amendment of the Institutional Development Plan (IFT), with special regard to structural reforms and giving special emphasis to determining the areas to be developed, maintained or to be reduced; in addition he shall submit a related detailed proposal for rationalising the training structure and for developing a strategy for human resource management*." This project strategy document cannot be rendered independent of the process of preparing the strategic proposals.

Thus the preparation of the strategy was simultaneously motivated and influenced, beyond the contractual obligation, by the increasingly strong competition between universities in Hungary, the increasing financial difficulties of the institution, and the changing higher education environment.

2.2 Short presentation of the 'Centres of Excellence' project of the University of Miskolc

System of objectives of the application of the University of Miskolc:

- Increasing the competitiveness and attraction of the region of Northern Hungary
- Modernising the economy and society of the region, mitigating its employment problems
- Establishing Centres of Excellence in the strategic research fields chosen, funding R&D+&I activities of European standard
- Improving the scientific impact of the institution within the next five years
- Increasing the presence of the institution in the national and international scientific life
- Performing and coordinating harmonised research work based on the existing infrastructure
- Keeping local young researchers in the region
- Attracting PhD students, post-doctoral researchers and renowned senior researchers from other regions to the region of Northern Hungary
- Establishing young research groups around senior researchers with outstanding scientific achievement
- Creating new research jobs (for senior researchers, post-doctoral researchers, young PhD candidates)
- Improving the recognition of researchers currently employed

The objective of the funding organisation in announcing the invitation for applications was to support the establishment of research groups with the critical mass necessary for pursuing R&D&I (innovation) activities of an international standard in priority research fields chosen by the applicant institutions and also to support the research and development work performed in these fields. It also had the objective of increasing the attraction of research through improving quality and excellence; one way to do so is to ensure the critical accumulation of infrastructure and intellectual capacity in priority research fields of strategic importance for the domestic economy and society and connected to R&D fields that are topical in international terms.

Elements of achieving the above objectives in the application are:

Developing intellectual potential

The institutions employ researchers recognised in international scientific life, 'schools' develop around their activities and nurturing talented young people is performed as a priority task on all levels, producing outstanding performance in doctoral programmes, thus training the new generation to carry on the academic and research work of the institution (and, in general, of higher education in Hungary).

Quality development of priority research fields

The institutions carry out further resource concentration in their priority research fields constituting a consolidated scientific portfolio, and use further considerable funds for their development. The objective is to support research activities which will produce

substantial utilised results in terms of increasing the attraction (image) of higher education.

Development of the institutional system of relations

The institutions consolidate their partnerships, developing national and international academic and research networks, and thus utilise their scientific results for the benefit of the society as well as in the economy, i.e. they publish their R&D&I results in journals with high impact factors and influential books, in patents and in new processes, as well as disseminating them in the training programmes.

2.3 Professional implementation of the project

Facts on the project TÁMOP-4.2.1.B-10/2/KONV-2010-0001) of the University of Miskolc:

Project title: 'Improving the Quality of Higher Education on the Basis of the Development of Centres of Excellence in the Strategic Research Fields of the University of Miskolc'

Period of project implementation: 1 March 2011- 28 February 2013 (24 months)

Project budget: 2.140 billion HUF

Funding intensity: 95%

Funder: National Development Agency

The University of Miskolc will perform its professional tasks organised into **four Centres of Excellence (CE).** The Centres of Excellence are constituted by **scientific workshops,** while the concrete research tasks are indicated by **R&D initiatives** in the application (Figure 1).

The main task of the Centres of Excellence is to establish successful research teams around senior researchers of international renown. New researchers shall join the research groups that are rather closed in several fields, improving research motivation and utilising the advantages of interdisciplinarity. In addition to achieving the set research objectives, fulfiling the set indicators is also of key importance.

The R&D concepts outlined by the researchers of the University compete also with each other, and hopefully several dozen of them will have developed into marketable products and processes by the end of the project.

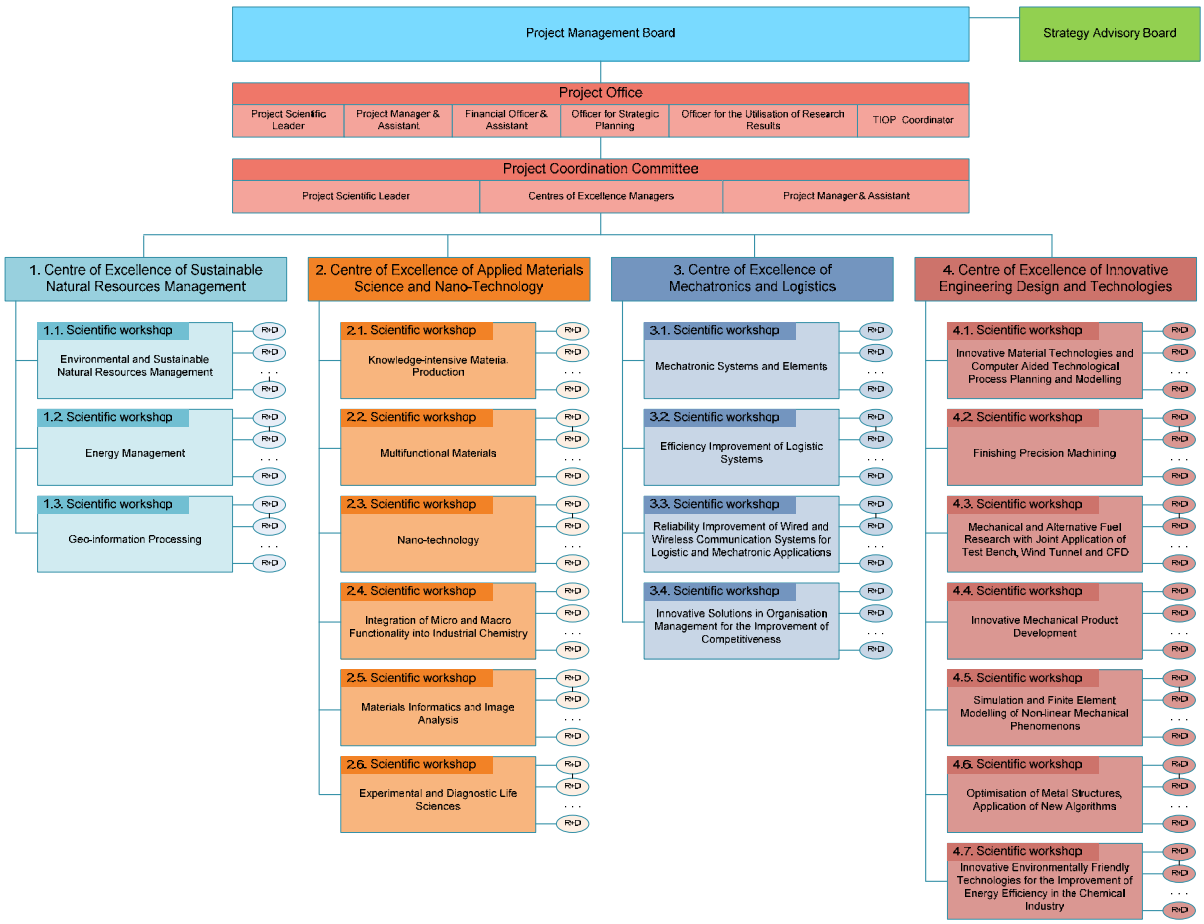


Figure 1. Structure of the project TÁMOP-4.2.1.B-10/2/KONV-2010-0001 of the University of Miskolc

2.4 The task of creating a strategy and its participants

As part of the project, the University of Miskolc has undertaken to prepare a strategy document, which consists of four elements of partial strategy:

1. **Human Resource Development Strategy**
2. **Infrastructure Development Strategy**
3. **Research and Development Strategy**
4. **Utilisation Plan of Scientific Results**.

The strategy documents have been prepared by the members of the **Strategy Working Group** established by the management of the project, they will be reported on and evaluated by an expert body, the

Members of the Strategy Working Group:
Prof. Dr. Gácsi Zoltán, professional leader
Dr. Szemmelveisz Tamás, project manager
Jámborné Dr. Róth Erika, director of human resources
Széll Gábor, director general for finance
Prof. Dr. Lukács János, TIOP-1.3.1. professional leader
Prof. Dr. Dobróka Mihály, vice-rector for scientific and international affairs
Dr. Deák Csaba, vice-rector for strategy and development
Dr. Bőhm József – CE 1
Dr. Mertinger Valéria – CE 2
Prof. Dr. Mang Béla – CE 3
Prof. Dr. Tisza Miklós – CE 4
Dr. Madarász Tamás, strategic planner
Prof. Dr. Palotás Árpád Bence, infrastructure coordinator
Roneczné Ambrus-Tóth Judit, assistant to the professional leader

Strategy Advisory Board, the members of which have been called upon by the Rector of the University.

Members of the Strategy Advisory Board:
Prof. Dr. José Carlos Quadrado (Instituto Superior de Engenharia de Lisboa),
Prof. Dr. Imre Horváth (Delft University of Technology),
Prof. Dr. Helmut Wolff (Technische Universität Berlin),
Prof. Dr. Lorenz Ratke (Deutsches Zentrum für Luft- und Raumfahrt Köln),
Prof. Dr. Karol Florian (Technická univerzita v Košiciach),
Prof. Dr. Eric Eddings (University of Utah),
Prof. Dr. Marko Torkkeli (Lappeenranta University of Technology),
Prof. Dr. Gaál Zoltán (Pannon Egyetem),
Dr. Szabó László (Heidelberg Cement Group)

The management of the project has formulated its requirements concerning the professional contents of the strategy, which are as follows:

- The strategy document is **the strategy of the Centres of Excellence, but also covers impacts on an institutional level**. The Centres of Excellence themselves define their current positions and future plans in the R&D&I field (R&D strategy), with special emphasis on the sustainability of the Centres of Excellence and on the development perspectives of their professional fields.
- The strategies to be developed are to **be in harmony with the Institutional Development Strategy adopted in 2010,** or have to justify any divergence with the necessary authority.
- The ideas formulated in the **concept of the Act on Higher Education being drafted** are to be taken into consideration in the planning process.
- **The tasks undertaken in the application for the title 'Research University' are to be taken into consideration** in determining the objectives.
- **The planning period** of the strategy covers **the implementation and maintenance periods** of the project as well. The objective of the strategy documents prepared is that they should **provide guidance on the mid-term research priorities and developments of the University** also after the completion of the project.
- In preparing the strategy, **the fulfilment of the relevant impact, benefit and output indicators** is to be kept in mind, in both the implementation and the maintenance periods of the project.
- The strategy documents also touch upon **the roles of other relevant projects** in progress at the University (or applied for by the University) (TIOP, TÁMOP) and how **they support the fulfilment of the strategic objectives.**

2.5 The vision determining the strategy, the system of objectives

At an early stage in creating the strategy, the members of the Strategy Working Group came to an agreement on the vision to be achieved.

Objective 1: In spite of the lack of success of the application by the University for the title 'Research University' submitted in 2010, the University of Miskolc has the objective **to achieve a more distinguished position in the competition of Hungarian research universities in the next 5 years and to be accepted into the league of research universities.** Considerable progress is needed to fulfil the evaluation criteria for the status of Research University, with the help of this and the other projects mentioned above, in the aspects of:

1. research capacity,
2. doctoral programmes and care for talented students,
3. research–publication activity, and
4. national and international research and development activities and revenue.

Due to the publication of the proposed text of the new Act on Higher Education, supplementation and modification of the system of objectives is justified. The draft Act on Higher Education projects that the participants of higher education in Hungary will be awarded the status of either university or college and there will be some institutions obtaining the status of priority higher education institution. The ranking envisioned in the act – and undergoing several changes of considerable extent – makes it justified to denote a new objective as a strategic objective, as long as it is not in contradiction with the previous objective.

Objective 2: Under the draft Act on Higher Education a university is a higher education institution which:

- is entitled to offer master programmes in at least two areas of education and to offer doctoral programmes and award doctoral degrees in at least two areas of education,
- employs academic and research staff (in the legal status of civil servants) of whom at least 50% holds a scientific degree (i.e., PhD or above),

- has at least three university faculties,
- has at least two doctoral schools, where – in the period of their existence – at least sixty doctoral candidates obtain a doctoral degree on the average within a period of five years;
- operates Students' Research Societies;
- is able to conduct programmes in a foreign language in part of the programmes offered.

Furthermore, the Government, for the purpose of achieving the objectives of the national strategy, in accordance with the relevant regulation, may rank a higher education institution maintained by the state as a priority higher education institution. A university or a university faculty offering programmes of outstanding standards and recognised in scientific life – under conditions determined by the Government – may obtain the qualification 'research university'. In order for the University of Miskolc **to comply with the criteria of quality higher education by 2014 and to be able to meet them on a long-term basis, it has to satisfy the following criteria:**

- at least two-thirds of the academic and research staff hold a scientific degree,
- one-third of the university professors hold the title 'doctor of the Hungarian Academy of Sciences' or have scientific performance of international standards demonstrably equivalent to it,
- the average number of peer-reviewed publications written by the academic and research staff is to be at least four hundred, with the majority published in international journals;
- the institution is to pursue joint research and training activities under agreements with the Hungarian Academy of Sciences,
- with the aim of fulfilling its research, development and innovation activities, the institution is to pursue entrepreneurial activities on its own or in cooperation with other players of the economy;
- at least one-third of its budget is to come from project funding, orders for services, or programmes in foreign languages offered to international students,
- that a PhD be a requirement for holding the position of senior lecturer in university faculties.

Objective 3: The two objectives given are closely related and are also in harmony with vision formulated in the Institutional Development Plan of the University of Miskolc,

according to which **the University of Miskolc is to become an internationally competitive research university by 2020** at the latest, depending on changes in the external conditions.

All these objectives present challenges for the institution in the following fields:

- introduction of comprehensive quality improving processes in the fields of research and training;
- improving the income-generating capacity, diversification of sources of income and simplification of the relevant regulations;
- improving the age pyramid of the academic and research staff, retaining well-prepared young academic staff and researchers.

3 HUMAN RESOURCE DEVELOPMENT STRATEGY

3.1 The task and the conditions for preparing the strategy

Budget of the University of Miskolc for the year 2011:

Revenues:
Estimated state funding (without student grants): 5.6 billion HUF
Own income: 5 billion HUF

Withdrawal of funding in 2011: 0.7 billion HUF

Main items of expenditure:
Wages & contributions: 6.7 billion HUF
Material expenses: 2.9 billion HUF

In the period of preparing the strategy, in 2011, a withdrawal of funds from higher education of an extraordinary amount took place, forcing the institution to carry out a thorough examination of its internal processes and take the appropriate steps towards a structural reform of the organisation and the rationalisation of the training structure. Influenced by the vision suggested by the concept of the new Act on Higher Education, the leaders of the University have unanimously committed themselves to a vision of quality higher education defining the position of the University of Miskolc in the mid-term, so the planning of human resources takes into consideration the relevant expectations included in the concept of the new Act on Higher Education as currently made public.

Since at the beginning of the project on 1 March 2011 the financial means were not available, and thus it was not possible to sign the contracts on the employment of those working in the project, the state existing at the time of asking for the data necessary for the preparation of the strategy (August 2011) was accepted as the starting data. There is no coverage for keeping the increased number of employees beyond the 24-month period of the project funded, in the maintenance period, but efforts are to be made with the purpose that the **new generation of academic/research staff** of the years to come should be found among **the young colleagues** involved in the implementation of the project. After the project is closed, every effort is to be made so that the University can obtain new project funding for the 'continuation'. The objective is not to achieve one-off, short-term 'booms'; efforts should be made to utilise the long-term effects of the funds provided by the project.

3.2 Age pyramid of academic and research staff

The composition by age of the academic and research staff of the University of Miskolc shows highly considerable differences from faculty to faculty, and marked differences can be seen among the Centres of Excellence as well. On the whole, at university level the age pyramid of the academic and research staff shows a relatively promising picture. The situation is worse concerning the non-academic/research staff, where ageing can be seen to a greater extent. However, this latter fact does not present a very serious problem, in consideration of the nature of the tasks to be performed and of the fact that it is generally easier to hire new staff for these jobs from the supply of the labour market. Among the faculties of the University, the Faculty of Mechanical Engineering and Informatics and the Faculty of Arts have a large proportion of the age group of over 55 years, thus at these faculties the issue of new academic staff will become of decisive importance in the near future. At the Faculty of Mechanical Engineering and Informatics, the project TÁMOP-4.2.1.B-10/2/KONV-2010-0001 is likely to play a considerable role in training the new generation. (Looking at the Comenius College Faculty, it also presents a threat that about half of its academic/research staff belongs to the age group of 55-59 years.)

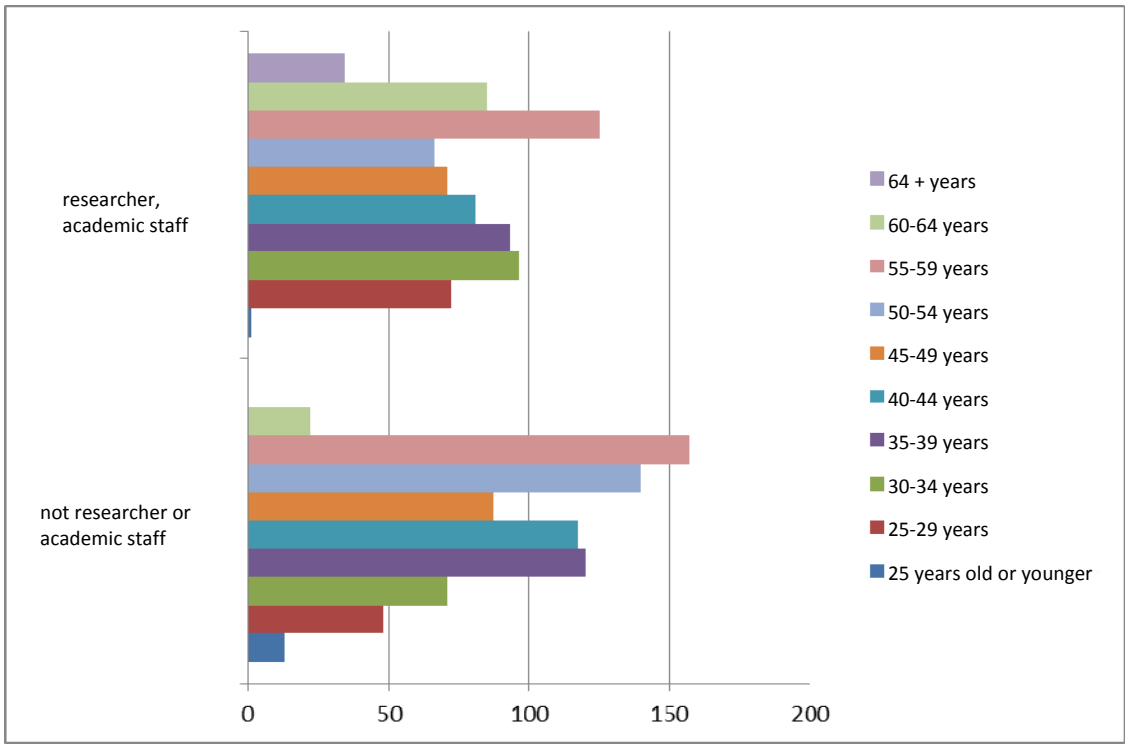


Figure 2. Age pyramid of the academic/research staff of the University of Miskolc (July 2011, source: AVIR)

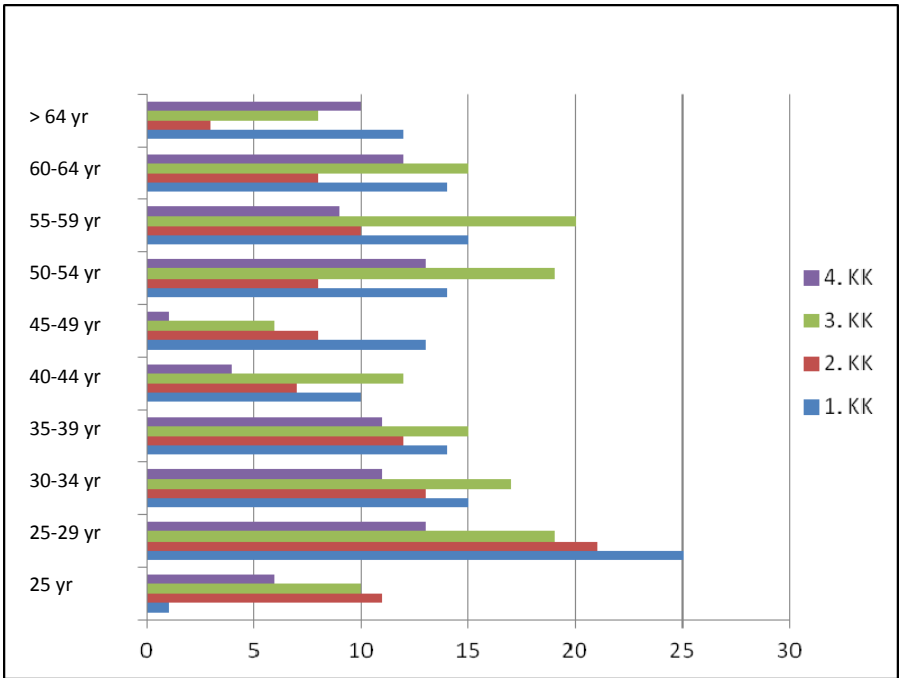


Figure 3. Age pyramid of the Centres of Excellence

The intention is twofold during the project period:

1. All faculties have realised that **'rejuvenation' and ensuring a new generation of academic/research staff** is indispensable for maintaining their ability to operate. The age distribution guaranteeing a balanced, unbroken path of development shows an age pyramid with its base widening.

   At the same time, it is indispensible to **retain senior academic/research staff producing appropriate scientific achievements, organising scientific workshops, directing the work of young researchers and having a high level of scientific qualifications** in order to satisfy the research university criteria, for increasing the university's own revenues, and for maintaining and improving international recognition.
2. This is the purpose served by the fact that senior academic staff holding scientific degrees can be employed after reaching the general pensionable age (university and college associate professors until reaching the age of 65 years and university and college professors until reaching the age of 70 years). University and college professors having reached the age of 70 years and meeting the requirements in the system of requirements of employment may be granted the title Professor Emeritus, which entitles them to be given/take a role in academic and research work, primarily in training

the new generation of researchers (in doctoral programmes). Currently there are such agreements in force with 41 Emeritus Professors.

The rate of academic/research staff working while also being pensioners is 4.3% on the university level. This is partly related to the age pyramid presented above, but there are also some striking values to be seen, such as in the case of the Faculty of Earth Science and Engineering (8.4%), the Healthcare Faculty (8%), or the Comenius College Faculty (7.7%). The employment of pensioners is affected to a considerable extent by legal regulations, whose contents change frequently, as well as by the professional expertise of the person in question and the intention of the heads of the organisational unit.

3.3 The rate of those holding scientific degrees

Among the academic staff of the institution 376 persons (68.49%), while among the research staff 10 persons (30.30%) hold scientific degrees. Three faculties employ an outstandingly high ratio of academic/research staff holding scientific degrees. The Faculty of Arts, the Faculty of Earth Science and Engineering and the Faculty of Materials Science and Engineering have ratios of 82%, 78%, and 73%, respectively, of academic/research staff holding scientific degrees. Most members of the Hungarian Academy of Sciences are also from the latter two Faculties. This is also essential because these two Faculties play significant roles in the activities of the project TÁMOP-4.2.1.B-10/2/KONV-2010-0001. It is essential concerning the criteria of high-quality higher education that the ratio of those with a doctoral degree and also holding a habilitation degree is the highest at the Faculty of Arts (21%), but apart from the college faculties, the other Faculties also present a nearly identical ratio. More than half of the academic/research staff holds PhD or equivalent scientific degrees, with smaller or greater differences at the individual Faculties. In the Centres of Excellence the ratio of those holding scientific degrees was as follows at the time of the beginning of the project:

- Centre of Excellence 1: 66 out of 89 members of academic/research staff (74.2%);
- Centre of Excellence 2: 37 out of 54 members of academic/research staff (68.5%);
- Centre of Excellence 3: 80 out of 112 members of academic/research staff (71.4%);
- Centre of Excellence 4: 31 out of 59 members of academic/research staff (52.5%).

Summing up the data above, it can be seen that taking all the Centres of Excellence into consideration, the number of academic/research staff holding scientific degrees is 214

persons (68.15%). Compared with the university-wide data, this shows that the Centres of Excellence made efforts to involve as many members of staff holding scientific qualifications as possible in their activities.

3.4 Connections between doctoral programmes and the project

The supply of a new generation of scientific staff either for the whole of the university, or for the Centres of Excellence involved in the implementation of the project, is closely related to the activities of the Doctoral Schools of the University. Since the beginning of the doctoral programmes (1993), a considerable part of the academic/research staff holding scientific degrees has obtained their PhD degrees at the University of Miskolc. The major data of the Doctoral Schools of the University of Miskolc are given in Table 1 (using data from the first half of 2011).

Table 1. Major data of the Doctoral Schools (DS) of the University of Miskolc

Doctoral Schools	Mikoviny Sámuel DS of Earth Sciences	Kerpely Antal DS of Material Sciences and Technologies	Sályi István DS of Mechanical Engineering	Hatvany József DS of Information Sciences, Engineering and Technology	Deák Ferenc DS of Law	DS of Enterprise Theory and Practice	DS of Literary Studies	*Total*
Number of core members	10	11	12	10	10	9	8	***70***
Number of state-financed PhD students	26	18	10	8	14	12	12	***100***
Number of fee-paying PhD students	7	5	4	5	19	25	6	***71***
Total number of PhD students	***33***	***23***	***14***	***13***	***33***	***37***	***18***	***171***
Number of candidates for the doctoral degree	4	16	12	8	11	7	7	***65***
Number of degrees issued	4	1	-	2	5	7	-	***19***
Of these employed by the University	***-***	***1***	***-***	***2***	***-***	***4***	***-***	***7***

The natural mission of the Doctoral Schools of the University is to provide the new generation of staff holding scientific degrees. Therefore – where necessary – the field of operation of the Doctoral Schools is to be widened so as to provide opportunities for employees of the University to find opportunities to obtain a degree in as wide a field as possible at the University. The supplementary funding of 500 million HUF provided by the project TÁMOP-4.2.2/B-10/1-2010-0008 'Harmonised Quality Development of the Academic-Scientific Workshops at the University of Miskolc' won by the institution will represent considerable progress in the operation of the Doctoral Schools in the next 20 months. It is desirable that as many as possible of the talented young people involved in

the project obtain PhD degrees by the closure of the project and then also in the maintenance period. Another objective is that as many as possible of the students involved in the implementation of the project enter the doctoral programmes during the running period of the project and its maintenance period as well.

A considerable portion of the academic/research staff of the University of Miskolc are involved in the implementation of the project: the management is counting on the involvement of **468 persons until the end of the project.** Table 2 shows the distribution among the Centres of Excellence and the number and ratio of the new employees.

Table 2. Ratio of new employees in the Centres of Excellence

	Centres of Excellence				Total
	CE1	CE 2	CE 3	CE 4	
Academic/research staff involved in the project	149	111	122	86	468
New employment in the project	20	25	6	5	56
Ratio of new jobs	13.4%	22.5%	4.9%	5.8%	12.0%

In view of the fact that 'rejuvenation', the education of the new generation, can be implemented first of all by involving young professionals already holding scientific degrees or close to obtaining scientific degrees in research work, Centres of Excellence 3 and 4, which are lagging well behind the average, have to take increasing advantage of the possibility of new employment so that the achievement of this objective is not endangered. In accordance with the indicators set in the project, **the number of academic and research staff holding scientific degrees and employed full time will increase from the initial number of 359 persons to 374 persons by the end of the project, thus the ratio of employees in this category will increase from 65.3% to 66.2%.**

3.5 Steps to be taken to satisfy the research university criteria

It is necessary **to increase the number of those holding PhD degrees, of doctors with a habilitation degree, the university and college professors and those holding the title of doctor of the Hungarian Academy of Sciences** – in the case of a decrease in numbers due to many being pensioned off, this is also needed to maintain numbers at the current level. The project may provide a considerable contribution to providing the conditions for scientific progress – with special regard to obtaining the PhD degree and the title of Doctor of the Hungarian Academy of Sciences; starting the habilitation proce-

dures – by means of increasing the mobility of researchers and supporting the publication of scientific papers. Table 3 includes the most important quality criteria.

Table 3. Comparison of the requirements of ranking as quality higher education institution

Requirements of ranking as quality higher education institution	Current state	Criteria
Ratio of academic staff holding scientific degrees	55%	67%
Ratio of university professors with the title doctor of the Hungarian Academy of Sciences	37.50%	33%
Number of accredited doctoral schools	7	2
Number of people having obtained degrees in the doctoral schools	131	60/5 yr
Number of peer-reviewed publications under the names of its researchers	641	400/yr

According to the indicators set in the project **the number of full-time employees holding scientific degrees** is 359 persons as an initial value, which will increase **by 15 persons to 374 persons** in the two years of the project (by the end of the second year). Counting realistically, it will not be possible to 'retain' those employed in the project after the completion of the project and the cessation of the funding; the total number of employees cannot rise. Since the data are on a university level and not decisive concerning the Centres of Excellence, there is no obstacle to the number of those holding scientific degrees remaining at the higher value of the time of the completion of the project. (The places of those whose employment status is terminated will be filled by those holding scientific degrees and having proved their worth in the project.)

Concerning those holding scientific degrees, the initial value is 65.3%, which will rise to 66.2% in the second year of the project and this will remain unchanged until the fifth year. If there is a decrease in the number of those with scientific degrees employed, this ratio can only be maintained if the total number of the employees decreases in the meantime.

In order to achieve the above objectives:

- Particular attention is to be paid to involving talented young people into research work. The project offers excellent opportunities for this through the involvement of undergraduate, master and PhD students and by imparting the knowledge of research methodology.
- It is necessary to increase the number of qualified academic/research staff on the one hand – primarily through young people who have performed well in the organised PhD programmes and obtained or pursuing PhD degrees, and,

on the other, by employing staff coming from the sphere outside the University and committed to an academic career.

- More intensive academic/research staff mobility is to be encouraged, both in terms of the staff of the university and of researchers applying and arriving from abroad.
- The administrative and assistant support necessary for the high-standard performance of the task is to be provided for the heads of the Centres of Excellence and those responsible for the implementation of the professional tasks, since the researchers should not be overburdened by administrative tasks.
- for achieving the set objectives, it is indispensable to supervise the implementation of the contents of the strategy on a continuous basis and to revise it on a regular basis (monitoring).
- A clear formulation of the quality criteria is of priority importance, as well as their continuous maintenance and enforcement and taking the necessary measures against those not meeting the requirements. For this purpose it is necessary to elaborate the aspects and methodology of performance assessment. Following the assessment, care should be taken to explore the causes of the deficiencies and to correct them.
- The involvement of young academic/research staff, particularly those holding scientific degrees, in international and national academic life and in professional and scientific organisations is to be supported.

Proposal

To revise the system of requirements of the academic staff and make the necessary amendments and corrections. Those responsible for the strategy for human resource developments shall prepare the relevant proposals.

4 INFRASTRUCTURE DEVELOPMENT STRATEGY

4.1 Background

This section of the strategy does not cover the building infrastructure in a wide sense, but focuses on the laboratories belonging to the Centres of Excellence (CE) and the machinery, equipment and instruments in them.

The evaluation of the situation is based on the data supplied by the individual laboratories. In some cases there are no data available, and this is denoted by '*no data*' (n.d.). In spite of this there were sufficient data for the analysis, apart from some exceptions.

4.2 Evaluation of the situation

Laboratories and laboratory units

Table 4 gives the list of the laboratories (self-standing laboratory, a set of departmental laboratories, centres, etc.) and their units named by the Centres of Excellence. A total of 55 laboratories (existing and under construction) and 103 laboratory units can be named, and in the following the 55 laboratories will be in the focus of the discussion, also due to the availability of data.

Number of Laboratory	Laboratory or laboratory unit	Organisational unit the laboratory belongs to	Number of units
Centre of Excellence of Sustainable Natural Resource Management			
1	Mineralogical and geological testing laboratory centre	Faculty of Earth Science and Engineering (MFK) / Institute of Mineralogy and Geology	5
	I/1 Optical microscope testing laboratory		
	I/2 Electron microscope testing laboratory		
	I/3 X-ray laboratory		
	I/4 Thermo-analytic (DTA) laboratory		
	I/5 Collection of minerals and rocks		
2	Geological database development and management laboratory centre	MFK / Institute of Geophysics and Geoinformatics	5
	II/1 Geophysical methodology and instrument development laboratory, Seismic laboratory unit, Geo-electrical laboratory unit		
	II/2 Kántás Károly geophysical modelling laboratory		
	II/3 Geoinformatics laboratory		
	II/4 Geodetics and spatial informatics laboratory		
	II/5 Demonstration mine		
3	Fluid mining training and research laboratory centre	MFK / Institute of Petroleum and Natural Gas Engineering	6
	III/1 Deep drilling laboratory		
	III/2 Reservoir mechanics laboratory		
	III/3 Petroleum production laboratory		
	III/4 Blow-out prevention and safety technology laboratory		
	III/5 Gas laboratory		
	III/6 Geothermal energy laboratory (in Fényi Gyula Jesuit Secondary School		
4	Earth science and engineering - environmental science training and research and innovation centre	MFK/ Institute of Mining and Geotechnology, Institute of Geography, Institute of Process Engineering and Environmental Process Technology, Institute of Environmental Management	15
	IV/1 Comminution – classification- agglomeration laboratory, Comminution laboratory unit, Agglomeration laboratory unit, Classification laboratory unit		

Number of Laboratory	Laboratory or laboratory unit	Organisational unit the laboratory belongs to	Number of units
	IV/2 Raw material preparation and waste processing technology laboratory, Gravitation dressing laboratory unit, Flotation laboratory unit, Magnetic-electrical and optical dressing laboratory unit		
	IV/3 Nano-processing technology laboratory		
	IV/4 Bio-processing technology laboratory		
	IV/5 Sewage technology laboratory		
	IV/6 Powder technology and compound flow laboratory		
	IV/7 Rock physics (rock assessment) testing laboratory		
	IV/8 Measurement technology laboratory		
	IV/9 Rock mechanics testing laboratory		
	IV/10 Geo-technology soil testing and engineering geology laboratory		
	IV/11 Stoping technology laboratory		
	IV/12 Noise-vibration measurement laboratory		
	IV/13 Hydrogeology laboratory		
	IV/14 Soil and water chemistry laboratory		
	IV/15 Pilot-plant training and research innovation development centre		
5	Testing laboratory centre of the associated department of the Research Institute of Applied Earth Sciences		1
6	Laboratory of the Institute of Energy and Quality	Faculty of Materials Science and Engineering (MAK)/Institute of Energy and Quality / Department of Combustion Technology and Thermal Energy	1
Centre of Excellence of Applied Materials Science and Nano-technology			
7	Plastic deformation and heat treatment (crystallisation) laboratory	MAK / Institute of Materials Science	1
8	Material and fine structure testing laboratories	MAK / Institute of Materials Science	1
9	Polymer technology laboratories	MAK / Department of Polymer Engineering	1
10	Chemistry laboratories	MAK / Institute of Chemistry	4

Number of Laboratory	Laboratory or laboratory unit	Organisational unit the laboratory belongs to	Number of units
	Element analysis laboratory		
	Organic analysis laboratory		
	Physico-chemistry laboratory		
	Colloid chemistry laboratory		
11	Casting laboratories	MAK / Institute of Metallurgy and Foundry / Department of Foundry	1
12	Silicate technology laboratories	MAK / Department of Ceramic and Silicate Engineering	1
13	Metallurgy and surface technology laboratories	MAK / Institute of Metallurgy and Foundry	1
14	Experimental and diagnostics life science centre	Faculty of Healthcare / Department of Nano-biotechnology and Regenerative Medicine., Department of Clinical Radiology, Department of Theoretical Health Sciences	5
	Phase I clinical pharmacology laboratory		
	Clinical diagnostics laboratory		
	Nano-biotechnology and regenerative medicine research laboratory		
	Recreation laboratory		
	Ultrasound diagnostics laboratory		
15	Thermo-mechanics simulation Laboratory	Faculty of Mechanical Engineering and Informatics (GÉIK) / Department of Mechanical Technology	1
Centre of Excellence of Mechatronics and Logistics			
16	Laboratories of the Department of Electrical and Electronic Engineering	GÉIK / Department of Electrical and Electronic Engineering	6
17	Laboratories of the Department of Physics	GÉIK / Department of Physics	3
	Electron spectrometrics laboratory		
	Laser laboratory		
	Demonstration laboratory		
18	Laboratories of the Robert Bosch Department of Mechatronics	GÉIK / Robert Bosch Department of Mechatronics	5
19	Laboratories of the Department of Machine Tools	GÉIK / Department of Machine Tools	1
20	Computer laboratories	GÉIK / Department of Information Technology	4
21	CAD laboratory	GÉIK / Department of Descriptive Geometry	1
22	Process control laboratory	GÉIK / Department of Automation and Communication	1

Number of Laboratory	Laboratory or laboratory unit	Organisational unit the laboratory belongs to	Number of units
		Technology	
23	Production informatics laboratory of the Department of Information Engineering	GÉIK / Department of Information Engineering	1
24	Wire and wireless industrial communication systems laboratory	GÉIK / Department of Automation and Communication Technology	1
25	Production informatics laboratory of the Department of Information Engineering	GÉIK / Department of Information Engineering	1
26	High tech logistics laboratory	GÉIK / Department of Materials Handling and Logistics	1
27	Integrated logistics and product identification laboratory	GÉIK / Department of Materials Handling and Logistics	1
28	Virtual logistics laboratory	GÉIK / Department of Materials Handling and Logistics	1
29	Teamwork laboratory	Faculty of Economics / Institute of Management Sciences	1
Centre of Excellence of Innovative Engineering Design and Technologies			
30	Welding laboratory	GÉIK Department of Mechanical Technology	1
31	ME-MTT heat- and surface treatment laboratory	GÉIK / Department of Mechanical Technology	1
32	Plastic deformation laboratory	GÉIK / Department of Mechanical Technology	1
33	Mechanical material testing laboratory	GÉIK / Department of Mechanical Technology	1
34	Metallography and surface testing laboratory	GÉIK / Department of Mechanical Technology	1
35	Plastics testing laboratory	GÉIK / Department of Mechanical Technology	1
36	Vehicle drive chain element machining laboratory	GÉIK / Department of Production Engineering	1
37	Cutting laboratory	GÉIK / Department of Production Engineering	1
38	Computer laboratory	GÉIK / Department of Production Engineering	1
39	Form and position testing laboratory	GÉIK / Department of Production Engineering	1
40	Surface roughness measuring laboratory	GÉIK / Department of Production Engineering	1
41	Quality control laboratory	GÉIK / Department of Production Engineering	1
42	ZF laboratory	GÉIK / Department of Production Engineering	1
43	Robotic assembly laboratory	GÉIK / Department of Production Engineering	1
44	Rapid Prototyping laboratory	GÉIK / Department of Production Engineering	1
45	3D measuring machine laboratory	GÉIK / Department of Production Engineering	1
46	CAD/CAM laboratory	GÉIK / Department of Production Engineering	1
47	Workshop laboratory	GÉIK / Department of Production Engineering	1

Number of Laboratory	Laboratory or laboratory unit	Organisational unit the laboratory belongs to	Number of units
48	Rapid product laboratory	GÉIK / Department of Machine and Product Design	1
49	Drive technology laboratory	GÉIK / Department of Machine and Product Design	1
50	Acoustics laboratory	GÉIK / Department of Machine and Product Design	1
51	Structural diagnostics laboratory	GÉIK / Department of Materials Handling and Logistics	1
52	Chemical machinery operation, strength and safety technology laboratory	GÉIK / Department of Chemical Machinery	1
53	Chemical machinery computer and simulation laboratory	GÉIK / Department of Chemical Machinery	1
54	Laboratory of the Department of Fluid and Heat Engineering	GÉIK / Department of Fluid and Heat Engineering	1
55	Motor diagnostics laboratory	GÉIK / Department of Fluid and Heat Engineering	1
Total			**103**

No data available
laboratory under construction

Table 4. Laboratories and laboratory units

Integration and management

Table 5 includes the most important data on the physical and virtual integration and management of the laboratories.

Table 5. Integration and management of the laboratories

Description	No data	Yes		No
	No. of labs	No. of labs	%	No. of labs
Physically integrated	4	23	45.1	28
Virtually integrated (in addition)	4 + 23	2	7.7	26
Total integrated	4	25	49.0	26
Laboratory with a manager	3	42	80.8	10
Appointed manager	3	3	5.8	–
Acting manager	3	39	75.0	–

As can be seen from the table, nearly half of the laboratories (49.0%) are integrated, mostly physically and only to a smaller extent virtually. It is an important fact, however, that these integrations do not extend beyond the limits of the Centres of Excellence (department / institute / faculty).

Three of the laboratories have appointed managers (5.8%) and 39 (75.0%) have acting managers; all the three appointed managers are heads of departments. No self-standing or integrated laboratory has a manager whose primary job is managing the laboratory.

Use of machinery, equipment and instruments

In the 55 laboratories a total of more than 200 machines, pieces of equipment and instruments, in some cases sets of instruments, are operated that qualify as having strategic importance. Surveying the use of the pool of instruments having strategic importance, it can be established that these items of equipment play important roles in the BSc, MSc and PhD programmes as well as in the scientific work of the PhD students, and in the realisation of industrial commissions and domestic projects (R&D). Insufficient data are available concerning international project and services (S); it can be presumed that most of the laboratories have no such use.

Income generating capacity, utilisation

Most important data of our infrastructure development projects:

Title: Complex Renewal of the National and International Competitiveness of the University of Miskolc (TIOP 1.3.1-07/1-2F-2008-0005)
Period: 1 April 2009-30 Nov. 2011
Funding: 6,234.7 million HUF

Title: Infrastructure and IT Development of the Centres of Excellence of the University of Miskolc (TIOP-1.3.1-10/1-2010-0012)
Period: 16 March 2011-31 Dec. 2012
Funding: 1.250.43 million HUF

An assessment has been made of the revenues generated by the pool of equipment discussed here and of its utilisation in general. It is to be noted that the pool of technical equipment of the University (primarily in the fields of activity of the CEs) has been considerably renewed in recent years and this process will definitely continue at least till the end of 2012 thanks to the currently running EU-financed infrastructure development programmes. Sufficient data are not yet available on the new instruments of high values (in a total amount of several tens of millions of Euro) or on those in the process of being purchased either in terms of income generating capacity or of utilisation, therefore the following statements are to be handled with care.

In the light of the above remarks, the average training income is 2,500 EUR/item/year, and the average R&D+S income is 7,000 EUR/item/year. Both figures suggest that there is still a lot to do for the managers/operators of the pool of equipment. At the same time, the result of 33.7% in terms of average utilisation cannot be called low.

Figure 4 shows the connections between the average utilisation data and the average income data of the pool of equipment of strategic importance in the period under examination.

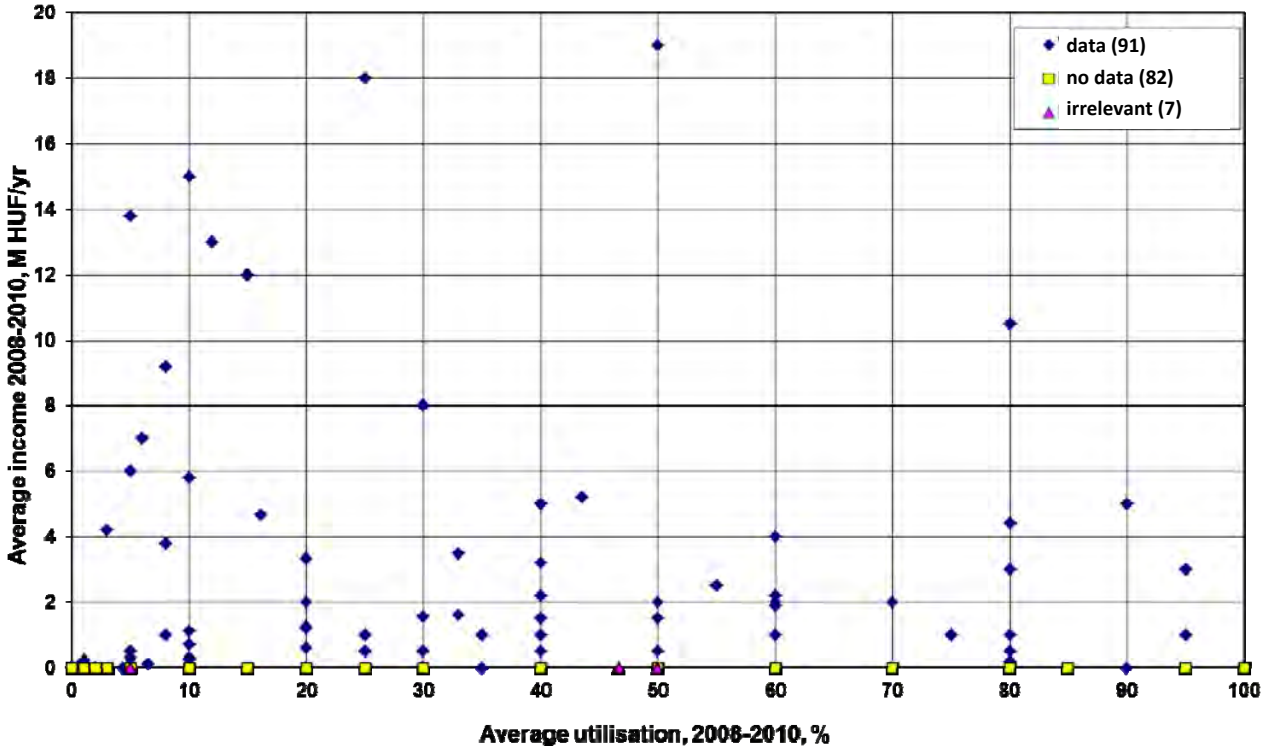


Figure 4. Relation between average utilisation and average income of the equipment of strategic importance in the period 2008-2010

It can be seen in the figure that the connection of the utilisation and income data is highly diverse. On the whole there are a great number of items of equipment earning low incomes and there are items of equipment with a high level of utilisation and generating low incomes, as well as items with low(er) utilisation and very high income generation. The high values in the latter group are explained by the favourable financial conditions of an EU-financed project promoting R&D cooperation. The project will be competed in 2012.

Two laboratories (3.9%) have public price lists, and one laboratory (2.0%) has a non-public pricelist. The former two laboratories belong to the Strategic Research Infrastructure (SRI) project. No organisation has a business plan, either at the equipment or at the laboratory level.

Laboratory staff, plans for developing the organisation and staff

For the majority of the laboratories (71.2%), no concrete persons (staff) can be identified as belonging directly to the laboratory. There are only 15 laboratories (29.8%) with staff being employed in the laboratory, which represents 32.5 employees. In view of the fact that several laboratories consist of a number of units, this seems to be a small number. At the same time it is also a fact that non-academic staff often perform several tasks, which means that their jobs can only partially be identified as belonging to the laboratory. Another fact is that the pool of equipment is used by academic staff/researchers and by PhD students in a considerable part of the laboratories.

Table 6 presents the integration, cooperation and staff development plans of the laboratories.

Table 6. Organisation and staff development concepts of the laboratories
(UM = within the University of Miskolc)

Description	No data	Yes		Staff
	No. of labs	No. of labs	%	persons
To be physically integrated (UM)	2	5	9.4	–
To be virtually integrated (UM)	2	38	71.7	–
Existing functional integration (not UM)	–	2	3.8	–
To be virtually integrated (not UM)	3	21	40.4	–
Existing physical integration (not UM)	–	1	1.9	–
Cooperation with the business sphere	2	34	64.2	–
Change of manager	2	8	15.1	–
Change of staff	2	11	20.8	+ 15

The majority of laboratories would wish to integrate functionally within the university and only one-tenth of them are thinking of physical integration. It is a welcome idea that 40.4% of the laboratories would also be willing to be virtually integrated with organisations/ laboratories outside the University. It is a surprising – and low – figure that only two-thirds of the laboratories would be willing to cooperate with the business sphere.

The laboratories are planning no fundamental changes in terms of staff. A change of the manager is planned by eight laboratories (15.1%), and a change of staff is panned by 11 laboratories (20.8%), which would mean a further 15 employees being allocated to the laboratories. The 32.5 persons given above and the additional 15 employees, even if taken combined, would not mean – on average – one employee per laboratory. These data predict a further increase in the relevant tasks of the academic/research staff.

The instrument development concepts of the laboratories

The development plans of the laboratories concerning machinery, equipment and instruments envisage purchasing 195 items of new instruments with a value of approximately 6 million EUR, primarily based on the currently running EU-financed projects. In addition to the existing 254 items of strategically important equipment, this development may be described as substantial.

A fundamental issue appears to be the decision of whether it is actually necessary to purchase equipment in that amount and of that value or not, as well as whether it is actually the items of equipment named that must be purchased.

4.3 Strategic objectives and the instruments of implementation

The strategic objectives of the laboratory infrastructure development and the individual elements of the implementation can be summed up as follows. The objectives are influenced not only by the R&D strategies of the Centres of Excellence, but also other measures of the government, which change suddenly in certain cases (e.g. the National Higher Education System).

Determining the development priorities of the laboratory infrastructure development

In view of the fact that the professional recognition, availability of resources and expenditure requirement/profit-generating capacity of the individual laboratories show a rather wide range, institutional-level (objective) priorities are to be set and formulated. The same principle is to be followed on the level of the Centres of Excellence as well. If it is justified, there may also be a shift of emphasis and a regrouping of resources necessary within and/or between the Centres of Excellence as they are currently envisaged. The priorities have to follow from the R&D strategies of the individual Centres of Excellence.

Preventing parallel developments

a) It is expedient to establish an *Instrument Coordination Group (ICG)* in order to prevent – or, more strictly formulated, to stop – parallel developments. One determinant responsibility of the ICG may be to ensure the regulated use of development funding, even by means of partial centralisation.
b) The establishment of the *public databases* indispensable for evaluation and partly under development at present is to be speeded up so that they can be used as soon as possible.
c) The virtual (internal) and physical (internal) *integration* of the laboratories is to be strengthened. In the integration it is expedient to cross the borders set by the Centres of Excellence (departments/institutes/faculties).
d) Relying on the work of the ICG, if necessary, *a modification* of the relevant parts of the *contract for funding* of the ongoing EU-financed infrastructure development project (TIOP-1.3.1-10) is to be considered.

Increasing the operational efficiency and income generating capacity of the laboratories

The operational efficiency of the laboratories is close related to the operational efficiency of the machinery, equipment and instruments. In their respect, an increase in the efficiency can be achieved by increasing their use and the income generated in a coherent way.

a) *The income generating capacity* is to be increased in the course of operation. For this purpose:
   - competitors are to be mapped, their capacities, skills and pricelists are to be explored;
   - pricelists of our own are to be prepared;
   - business model(s) and plan(s) are to be prepared;
   - normative requirements are to be used to sanction insufficient utilisation.
b) The virtual (internal and external) and the physical (internal and external) *integration* of the laboratories is to be strengthened.
   During the teaching session, the laboratories have to serve the purpose of teaching primarily, but in periods beyond that time (in the afternoon, even-

ing, in the summer, etc.) they can be used for income-generating services performed by external commission

c) The laboratory infrastructure is to become a base for the care for talented students, and the use of the pool of instruments for teaching our students is to be increased.

d) Laboratories which directly satisfy the concrete and at least mid-term requirements of *external (business) players* are also to be developed. For this purpose:
   - External players are to be involved in the development process, on the one hand as formulators of the demand, and, on the other, as the providers of funding (investment, maintenance);
   - The relevant communication (PR) activities are to be strengthened. In order to achieve the objective, together with the external (business) players,
     - Joint grant application activities are to be pursued,
     - Joint entrepreneurial activities are to be pursued, for which mutually beneficial forms have to be sought.

e) *The operational efficiency* of the laboratories is to be measured and assessed on a regular basis. The measurement of the use of public utilities is to standardised and an algorithm is to be elaborated for the expenses to be charged to the laboratories.

f) The – extraordinary –regulations for withdrawal of funding in force until 31 December 2012 are to be revised and the regulation is to be changed in a direction *encouraging increases in efficiency.*

g) It is desirable to execute *changes in personnel* and regroupings, parallel with the integrations implemented. It is expedient to put responsible managers in charge of the individual (integrated) laboratories, to allocate staff to them, and to formulate accountability requirements for them.

Proposal

In order to achieve the above objectives, in the elaboration of the new financing and operation model of the University of Miskolc, the tasks related to increasing the operational efficiency of the laboratories shall be taken into consideration. The person responsible for preparing the strategy on infrastructure development shall prepare the relevant proposals.

5 UTILISATION PLAN OF SCIENTIFIC RESULTS

At the university the different faculties pursue research work in diverse fields of science, which results in some diversity in the utilisation of the results as well. The utilisation of the scientific results achieved/to be achieved is realised on several levels; the strategic objectives have also been determined separately for these levels.

1. As the matter concerned is research at a university, the introduction of the results in academic programmes as one means of utilisation arises naturally from the classic system of responsibilities of universities (safekeeping, enhancing and imparting knowledge). This is the foundation of the operational scheme of universities generally accepted and followed since Humboldt: good teaching is only possible through academic staff pursuing research work, producing genuine results in their professional fields.
2. Researchers present their results in national and international forums, meetings and conferences and publish them in various forms: in print or electronically.
3. The natural medium of research work is collaboration, which is of decisive importance for the success of projects, the continuity of research and for maintaining connections with practice. The income-generating activity of the engineering faculties is fundamentally realised through cooperation with industrial partners; therefore, industrial cooperation has a priority role in the utilisation of new scientific results.

5.1 Introduction of scientific results in academic programmes

The modern university is characterised by **the dynamic unity of teaching and research.** The Hungarian financing system is attempting to promote a balance of the two spheres of activities, but its instruments and methods are ripe for being renewed. **Earlier** at the University of Miskolc an overemphasis on the academic normative **made the recognition of research achievements** mostly **formal**, together with recognition of the strategic significance of research. This has resulted in the fact that the institutes and departments saw the pledge of the future in taking on an excess of academic tasks to the extent that **the majority of academic staff has hardly any time left for performing their research tasks.** No wonder that this system of values – existing for a considerable

time now – has hindered publication achievements and at some faculties even the obtaining of scientific qualifications and higher scientific degrees. The Institutional Development Plan of the University of Miskolc, setting out new perceptions, is attempting to maintain the equilibrium of academic and research work in the long term. This situation is markedly supported by the TÁMOP project by undertaking to implement a declared research program presenting considerable professional challenges by means of requiring publication achievements, representing a change of paradigm.

The integration of the new scientific results **in academic programmes** will bring changes both in the BSc and in the MSc programmes in terms of incorporating research results into the daily teaching activities, the lectures and the practical classes. This activity is greatly promoted by the previous and the ongoing EU-financed (TIOP) infrastructure development. Other – also EU-financed – projects (HEFOP and TÁMOP) facilitated **writing teaching materials** primarily, thus the teaching materials, lecture notes and digital teaching materials have been renewed to a considerable extent or have been created in the first place.

The students of the University of Miskolc will make the most efficient use of these new or newly available bodies of knowledge, if **they become available in printed** and/or **electronic form at an inexpensive price** (considerably cheaper than the current photocopying price). Failing that, we will see a continuation of the unfortunate trend that the majority of the students do not possess (the rather expensive) textbooks, lecture notes or other teaching material. A solution is provided by the new, high-performance and outstandingly cost-efficient printing press of the University, together with creating the possibility of the connected **online, user-friendly individual orders.**

Beside the appearance of research results and methods in the practical training, the **involvement of students** in ongoing research work is to be strengthened. For example, in the framework of activities in the Students' Research Societies, students become familiar with the methods of scientific research and can see the work of successful research teams from inside. All this will serve to improve **the attraction of a scientific/research career,** to improve the standard of student BSc and MSc theses, and to encourage **a continuation of studies** (MSc, PhD).

Doctoral programmes are based on independent research work, and therefore the utilisation of research can be fundamentally regarded as solved. Development can be achieved by **increasing the number of PhD students**; the material foundations of this are currently also being created by a variety of EU-financed projects.

5.2 Publication strategy

The Institutional Development Plan of the University of Miskolc sets the medium-term objective of achieving ranking as a research university. The submission of application for the title of research university resulted in a considerable renewal of the publication strategy of the University of Miskolc, for it placed the main emphasis on publications published in internationally peer-reviewed journals. The project requirements and the recent political decisions concerning higher education also encourage **increasing the number of publications published in Hungarian and international journals.** Note that the criteria for ranking as a research university require 400 publications (published in peer-reviewed journals) annually, with *at least two-thirds of them published in international journals.*

Table 7. Data on the Hungarian and international publications of the academic and research staff of the University of Miskolc, 2004-2010

	2004	2005	2006	2007	2008	2009	2010
MFK: Earth sciences	177	198	228	207	232	212	117
MAK: Materials science	93	111	72	106	69	152	72
GÉIK: Engineering, informatics	361	475	443	390	336	513	183
BtK: Humanities	265	286	321	306	379	212	86
ÁJK: Law	256	269	278	250	366	282	130
GtK: Economics	177	239	257	285	182	169	53
Total of university faculties	**1,329**	**1,578**	**1,599**	**1,544**	**1,564**	**1,540**	**641**

In view of the fact the **publication presence is not a strength of the University of Miskolc in general** (see the data in Table 7 and the study "A magyar tudomány helyzete a felsőoktatási intézmények szemszögéből" (The Situation of Hungarian Science from the Aspect of Higher Education Institutions), the task is not a minor one, and the system will not change sufficiently rapidly without achieving it.

Encouragement may be of several layers. Consideration is to be given to the issue of recognising those achieving above the average also in **financial terms** in addition to **moral recognition** ('Publication of the Year', Author of the Year', etc.). In this framework the ongoing research university project allocates **an individual special bonus** (EUR 400) for every new publication having an impact factor, but the **motivation of communities** has also arisen (there is a faculty where this is already practice): a small portion of **the budget** can be allocated on the basis of the publication activity.

A practical means can be represented by developing institutional publications (e.g. Publications of the University of Miskolc) into internationally peer-reviewed journals and publishing them on a regular basis. An important element in this is establishing an internationally authoritative editorial board in each professional field.

Publications in quality, peer-reviewed journals (for example, but not exclusively, those with an impact factor) are to be treated with priority significance in awarding a **PhD title** and in the evaluation of **advancement at university level.**

The researchers working in various professional fields at the University often raise the problem that their **particular professional field has no international journal of merit,** and especially that there is no publication opportunity carrying an impact factor which can be monitored on the Web of Science as well. Although it is true that the possibilities and customs of the individual professional fields differ, it is worth making a comparison with Hungarian rivals. It is worth comparing the indicators of the publication presence of our researchers with the publication data of the Budapest University of Technology and Economics in the professional field of engineering and technology, those of the social scientists with the relevant data of their counterparts at the Eötvös Loránd University or at the University of Debrecen. The results speak for themselves and verify the possibility of considerable improvement.

5.3 Strategy of knowledge transfer towards the business sphere

This section deals exclusively with the activity of knowledge transfer provided for companies, and does not cover similar activities towards other target groups or the characteristics of R&D&I activities preceding knowledge transfer – or does so only to the extent that is justified by the interpretation of the study. The objective of the strategy is to develop the activity of knowledge transfer, primarily as a foundation for increasing the revenues generated by the activity.

Situation analysis

The research potentials and the utilisation of the research potentials of the eight faculties and other organisational units of the University of Miskolc show a highly varied picture. This can be established with consideration of the fact that the performance of the University of Miskolc is not satisfactory in the field of knowledge transfer compared with the quantitative and qualitative indicators of the professional background, number of researchers, and pool of instruments. The main reasons can be summed up as follows:

- Short-term approach: there exists no appropriate practice of marketing intellectual products; primarily concrete commissions by companies are carried out; the development, product development and other connected innovation and training activities following the research phase are on a one-off basis;
- Existing knowledge transfer organisation, but poorly defined or not properly performed task and scopes: insufficient intellectual property management, support for management, involvement of funding, incubation processes, training and dissemination;
- Lack of sufficient financial funds and system of financial relations: knowledge transfer processes which cannot be managed without providing access to our own and external funding required for the further development of the research and development projects and a capitalising on the intellectual products.

Objectives

The primary objective of the knowledge transfer strategy is to ensure that the knowledge created at the University of Miskolc should be utilised to the greatest possible extent and the resulting material and moral benefit should contribute to the highest possible extent to the quantitative and qualitative development of the knowledge potential of the University.

On the basis of the situation analysis, the following part objectives can be formulated for achieving the main objective:

- Assessment of the knowledge basis and potential, its evaluation and setting priorities, concentrating primarily on the areas where the University has a comparative competitive advantage or is able to achieve one.
- Creating transparent processes and rules, creating interests, for the purpose that knowledge with a profit-making capacity should remain in the sphere of interest of the University of Miskolc.
- Propagating an innovative and entrepreneurial approach in the protection, recognition and utilisation of intellectual products.

In order to achieve the above objectives:

- Academic and research staff publishing above the average shall be recognised in material terms as well as public recognition (by means of the distinction 'Publication of the Year', 'Author of the Year');
- In renewing the financing and operational processes of the University of Miskolc, a certain part of the budget (part of the scientific normative) shall be allocated on the basis of the publication activity;
- The Publications of the University of Miskolc shall be developed into internationally peer-reviewed journals and regular appearance shall be ensured; for this purpose internationally authoritative editorial boards shall be set up in each professional field;
- In the field of knowledge transfer to the business sphere, the current compartmentalised organisational structure shall be eliminated and an efficient knowledge transfer organisation shall be established through clearly determined tasks and scopes;
- Individual interests shall be created and clear and transparent rules formulated in order that knowledge with an income-generating capacity shall remain in the sphere of interests of the University of Miskolc.

Proposal

The person responsible for writing the utilisation plan of scientific results shall prepare the relevant proposals.

6 RESEARCH AND DEVELOMENT STRATEGY

The research and development strategy (hereinafter: R&D strategy) of the University of Miskolc is a part of the comprehensive university strategy. The primary aim of the R&D strategy is to determine the strategic direction(s) for organisations and individuals involved in scientific research activities of the university, to establish the main areas of emphasis and boundaries of R&D activities, and to indicate the required financial resources needed to achieve the set goals and implement developments, as well as to declare the core values and interests of the university.

In addition, the further aim of the R&D strategy is to create layers and groups that are capable of providing outstanding performance and working in an environment with optimal facilities, that are strongly dedicated to publishing papers of international standards, and that conduct research that is capable of generating competitive, project- or industrial-based fund raising and of winning international prizes, and that will establish collaboration with Hungarian and foreign research institutions and industry.

The elaboration of R&D strategy – in line with the institutional R&D strategy – targets research areas of high priority and is in close synergy with the human resources strategy, infrastructure development strategy and with the plan of utilisation of research and scientific results.

The university has identified four research areas of high priority that are in line with the Research University Program. They are as follows:

1. Sustainable natural resources management
2. Applied materials science and nano-technology
3. Mechatronics and logistics
4. Innovative machine design and technologies

The comprehensive R&D university strategy program includes R&D sub-strategies of four research areas of high priority, whose structure is as follows:

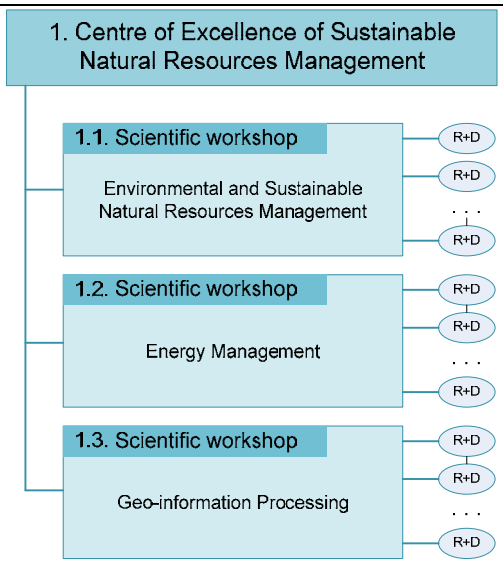
- Situation analysis: consideration of external environmental conditions and internal infrastructure;

- SWOT analysis: analyses of strengths, weaknesses, opportunities and threats;
- Monitoring system: a tool for measuring progress towards meeting the objectives and evaluating performance;
- Impact analysis: analyses of external and internal impacts.

As for the project impact, it can be generally assumed that the above-mentioned research areas enhance 'knowledge transfer', promote the relationship between the institution and business sectors, raise educational standards, retain professionals in the region, provide a knowledge-based background to community economic development projects and attract more investors to the area. A favourable outcome of the project enables the institution to further promote training and research areas and thus to become a key player in regional development, whilst its increasing intellectual potential significantly contributes to the development of the university and the region.

As a result of the planned measures, a gradual improvement is likely to be experienced in approaches to service-provision and innovation, in the retention of research positions and the increase of their distinction and potential, as well as in a R&D-oriented approach and in the integration of the knowledge gained into education and industry.

6.1 Centre of Excellence of Sustainable Natural Resources Management R&D Strategy



Budget of CE: 576.6 million HUF

Director: **Dr. Lakatos István**, HAS member

Number of scientific workshops: 3

Number of researchers involved: 149

Number of new staff: 20

Number of PhD students involved: 22

Situation analysis

Human activities are directed to meet human needs. This is achieved in the process of production and consumption. This process is a fundamental condition for human existence. The production process aimed at meeting human needs requires 'intellectual energy' (knowledge), raw or base materials, energy, supplementary materials as well as air and water as technological agents and 'environmental elements' (natural resources). Nature and the natural environment (natural resources) provide conditions for human existence. Humanity lives on the Earth and from the Earth. When performing activities related to meeting human needs, people have a considerable impact on their environment. On the other hand, they also have a moral responsibility for the earth, which arises from their commitment to protect the environment.

The social and economic development taking place on the Earth results in the increase in population (currently already 7 billion) and in consumption (production meeting their needs), which leads to a growing demand for natural resources. It is a proven fact that the annual global GDP growth stimulates an increase in mining production performance (due to the growing demand for mineral and raw materials resources). The primary aim

is to decrease or even to eliminate the inter-relation between the pace of global GDP growth and the demand for raw materials.

Water, the 'technological agent', is another indispensable 'natural resource' and a pre-condition for life. It is characterised by both abundance and shortage. Although water covers two-thirds of the Earth's surface, only 2.5% is the fresh water that provides vital living conditions for the Earth's ecosystem. Our civilization's waste and contamination of water have become a serious concern, since available fresh water reserves in the world have been endangered. It is obvious that water resources management, water quality, water reserves and environment protection require unified and river-basin oriented research and control as well as technological and legislative regulations.

In 2000 the European Parliament and Council adopted the EU Water Framework Directive, which established a framework for community action in the field of water policy, principles of cooperation and a water management strategy. Research, development and practical activities related to water resources management require hydrogeological, hydrological, environmental, geological, technological, engineering, legal and economics specialists and their knowledge.

The third global problem is the controversy surrounding the shortage of energy resources and the growing demand for them. In 2005, for the first time in the history of the European Union, there was a demand for a common long-term energy policy, which resulted from a dramatic increase in oil prices and challenges in the area of climate change. In 2006 the European Commission published a Green Paper with the title 'A European strategy for sustainable, competitive and secure energy'. After this move documents determining current energy policy were also adopted: the Energy Efficiency Action Plan (2006) aimed at achieving a 20% improvement in energy efficiency and the first Energy Policy of the European Union (2007). EU energy goals are incorporated into the Energy 2020 Strategy, which aims at developing a resource- and energy-efficient economy with low CO_2 emissions. This involves decreasing energy consumption with economic growth, decreasing CO_2 emissions, or properly managing emitted CO_2, and elaborating an integrated system promoting competitiveness and improving the energy supply. The new National Strategy and Climate Policy of Hungary formulated the mid-

dle- and long-term energy objectives, which harmonise with the objectives of other EU member state. An objective of this CE is to promote paradigm change.

Today's scientific society is characterised by the exponential growth of information. This is especially true in the field of earth sciences. The source of information is measurements, since it is geological and geophysical research that identifies the resources of mineral raw materials. After processing and evaluating the measured results, extraction sites are determined. In the application of earth sciences there is a growing demand for 3D processing methods (or 4D in the case of monitoring). Geological and earth science information is obtained from the processed measurements without which the present production technologies cannot be operated efficiently. Geodata acquisition, registration, storage, processing and interpretation methods are of the utmost importance at the international level. This encompasses a wide range of data. The CE measures, collects and analyses data related to the physical parameters of rocks, geological data, measured data and data obtained from environmental engineering measurements. Apart from collecting data, the activities of integrating these data into space and geo-information systems, developing interpretational methods related to development of processes, and dealing with reading the geological and earth science information contained in the data play an important role in research.

SWOT analysis

CE strengths	CE weaknesses
- The main strength of the CE is the accumulated professional and scientific experience of the staff and the decades-long international co-operation in the field of research - Professional and scientific achievements, their recognition and practical application at national and international levels. - The educators and researchers working in the CE., who are known and recognised in their fields - The significantly improved research infrastructure and fruitful collaboration with other research workshops in the sub-fields of high priority research topics.	- Considerable differences existing between scientific potentials and available human resources of particular research workshops. - The unfavourable age composition and the shortage of talented and young researchers in some research workshops. - Lack of mobility and of entrepreneurial spirit in some research groups. - Considerable differences in willingness to participate in national and international co-operation. - Managerial skills required for successful performance of research, practical handling, distribution and utilisation of research achievements.
CE future opportunities	**CE future threats**
- Despite a large amount of uncertainties, the CE sees many opportunities in the coming years and decades. - Being the only national scientific community in several professional and scientific areas, it can undertake major research tasks in several topic areas in international co-operation and meet national and international demand. - Further development of on-going projects, launching new co-operation projects with economic partners, multinational companies and small and medium-sized enterprises to gain mutual benefits for both sides. - Expanding CE competence areas and conducting research in professionally new fields. - Further expansion and development of current international relationships, initiation of new ones.	- The CE's future is threatened by economic, legislative, organisational and institutional uncertainties and unpredictable phenomena experienced in the whole society, economy, education, and national and international systems of relationship. - It is also threatened by economic instability, extreme cautiousness and pessimism, lack of development concepts, unwillingness to make efforts as well as by groundless concerns arising from professional, scientific and financial challenges. - Operational and development limits, overexploitation of the established and produced mental and economic resources, and using these resources for other purposes.

The Faculty of Earth Science and Engineering at the University of Miskolc has been involved in mining, exploiting, processing and distributing hydrocarbons, environmental protection management, natural resources management, water resources management, water reserve protection, geological research, geo-information processing and interpretation of R&D activities for several decades (and in some areas for centuries).

The CE supplements competencies of the Faculty of Earth Science and Engineering with additional competencies of the Faculties of Materials Science and Engineering, of Economics and of Law. Due to the social and economic reforms the former state-owned research workshops and centres (KBFI, VITUKI, MÁFI, KFH, KGI, SZIKTI, etc.) were closed down, transformed or downgraded. As a result of this, departments and institutes of the University of Miskolc have been playing an increasingly important role in the management of sustainable natural resources and in some areas of environmental protection

(waste management, damage remediation, etc.) and their tasks have increased in the past few years. As for energetic, the intensity of university research has increased somewhat since the privatisation of Hungarian energetic companies in the mid 1990s. Taking account the opportunities in this field, considerable resources have been invested in the development of laboratories as well as in research and infrastructure in the past few years. Great emphasis has been laid on nurturing a new generation of scientists, and the role of PhD courses in this process has also increased.

The demand for the CE is justified by the amount of performed R&D activities and the research projects managed by Scientific Workshops, whose total value amounts to 300-400 million HUF. The available intellectual potential and human resources provide a solid foundation for further development of the CE, its future performance growth and toward ensuring a new scientific generation.

Objectives and tasks of the Environment and Sustainable Natural Resources Management Scientific Workshop

- to survey the regularities in environment-oriented natural resources management and to promote a unified natural science, technical, economic and legal approach;
- to identify and to analyse theoretical and practical problems of raw material management and utilisation while keeping in view various environmental issues, and to develop environmentally sensitive exploitation and preparation processes;
- to locate new and unexploited natural resources and to promote their practical utilisation;
- to adopt a unified 'life cycle approach' in mineral raw material management and waste management, to realise a 'waste raw material' principle and to conduct research into the already available and into the required technical, economic and legislative criteria;
- to conduct research on new waste management and waste utilisation processes, their development and practical implementation;
- to conduct fundamental hydrogeological research on the geological structure of water reservoirs, to locate, explore and exploit groundwater reserves and conduct basic and applied research related to them;

- to investigate theoretical and practical issues of water resources management, paying special attention to water bodies stretching behind the nation's borders;
- to conduct theoretical and practical research on national and international legislative systems related to environment-oriented sustainable natural resources management.

The **main research tasks** (environment-oriented mining) promoting the implementation of objectives are:

- to conduct theoretical and practical geological research at national and international levels and to locate new water sources;
- to fully utilise the raw material sources explored and opened for mining purposes (to minimize production losses);
- to conduct research on exploitation techniques and technologies, to analyse and develop exploitation and dressing systems and machinery;
- to expand the utilisation of mineral assets (to minimise dressing and processing losses);
- to analyse impacts of exploited secondary materials (slurry, tailings, etc.) on the environment and to fully utilise and use these;
- to recycle production and consumer waste and to conduct research on new applications of industrial waste of huge volume (cinders, flue ash and technological waste);
- to research and apply substitute materials of mineral origin;
- to protect water reserves, to ensure drinking water supply, to treat and utilise exploited and sewage water; to develop risk-based remediation processes;
- to examine the impact of extreme weather conditions on groundwater reserves;
- to perform removal mining activities;
- to develop environmentally-friendly production technologies, to increase environmental security and to carry out recultivation activities.

The on-going Social Renewal Operational Programme (TÁMOP-4.2.1.B-10/2/KON-2010-0001), the 'Improvement of Standard of Education in Higher Institutions Based on Centres of Excellence and the Strategic Research Areas of the University of Miskolc' project and several other resources ensure **meeting the objectives and performing the tasks of the Environment and Sustainable Natural Resources Management Scientific Workshop** and the **financial resources required** for their implementation.

Factors significantly contributing to the success of the **'Environment and Sustainable Natural Resources Management' Scientific Workshop** include the already won projects related to the competence areas of the scientific workshop, further opportunities to apply for other grant projects, involvement in proposed and potential projects offering innovative topics and funded by companies and business enterprises, the research services and the expert work provided by the workshop.

The successful performance of the work undertaken by **the workshop** is and may be ensured by the available research potential, partly by **human resources** hired from other technical, economic and legal areas and by new researchers (young co-workers with PhD degrees) recruited during the implementation of the research objectives. Only an integrated approach and the research of topics in represented professional areas can bring about results recognised at national and international levels. Isolated and low-calibre researchers are not viable. The **research infrastructure and the research environment** are **available** for meeting the formulated objectives and tasks. Perhaps some devices, equipment and services may be required to accomplish the tasks, but they can be purchased from our own or external financial resources.

The **fundamental short-term objective** is to make the work of the scientific workshop known and recognised nationally and internationally. Conducting R&D&I activities, getting involved and successfully participating in international research projects, generating common research and striving for international application of the achieved results are objectives of high priority.

2-year objective	To make the Environment and Sustainable Natural Resources Management' Scientific Workshop known to the national scientific community (to compile and edit a publication)
5-year objective:	To make the Environment and Sustainable Natural Resources Management' Scientific Workshop known to the international scientific community (to hold an international conference and edit a publication)
10-year objective	The Environment and Sustainable Natural Resources Management' Scientific Workshop should become a known and recognised research partner in the national and international scientific community by managing its own projects (continuous participation in international forums and research projects)

Objectives and tasks of the Energy Management Scientific Workshop

The direct objective of the project is to establish an energetics scientific technology centre at the University of Miskolc that promotes the application of renewable and non-conventional gases, geothermal energy, and biomass in a wide range of areas, and contributes to their realistic accomplishment by utilising the available national potential and achievements in as wide a range as possible. Another objective is to develop professional knowledge and competencies within the framework of the scientific technology centre that promote energy efficiency and reduce CO_2 emissions in particular sectors and regions. The project aims at developing selected areas that have characteristic features favourable over the average, or the areas where the engineering faculties of the University of Miskolc have already achieved outstanding results. The **Energy Management Scientific Workshop** is involved in several sub-projects, briefly described below.

Reduction of carbon dioxide emission in coal-fired power plants by utilising the storage capacity of depleted oil and gas fields. Although the knowledge required for capturing carbon dioxide, transporting it by existing pipelines, inserting it in reservoirs and operating the reservoirs is available in the carbon dioxide industry, the applied processes are not cost-effective enough. There is a growing need for vigorous innovation and close international co-operation in order to meet the EU objectives.

Application of renewable and non-conventional gases. The academic staff of the university, commissioned by several national and international projects and R&D projects, have investigated the opportunities and conditions of application of non-conventional hydrocarbon gases and biogases generated from dumping sites, sewer systems and agricultural waste. The sub-project aims at further enhancing the research funded by the project and conducted by the academic and research staff within the framework of various international collaborations so that could the researchers can contribute to the utilisation of renewable gases in Hungary on a larger scale.

Geothermal energy utilisation. There are considerable geothermal resources in Hungary. It is obvious that the cost- and energy-effectiveness of these projects is low, on a world scale. The sub-project aims at providing a basis for an R&D&I process that achieves outstanding results with the focus on effectiveness.

Greater biomass utilisation. There is a large potential in transforming biomass into energy in Hungary, far beyond the current levels (for biogas, incineration, gas and incineration, gas and electricity). The sub-project aims at creating conditions for research that transforms the current system into a more sustainable one, less dependent on imported fuels and based more on renewable energy resources.

The project objective is to foster the R&D&I potential of the academic and research staff of the University of Miskolc in the field of energetics, and to expand the international student exchange programme with summer industrial placements and semesters abroad. The aim of doctoral school programmes is to offer research topics on energetics and to increase the number of study trips. Project tasks have an encouraging impact on the academic and research staff, as well as enhance the publication activities of PhD students, enabling them to publish papers of higher quality.

The accumulated experience of the **Centre of Excellence** provides an **opportunity** to increase its **revenues** from R&D&I related to its scientific workshop competencies by **30-50%.** This target can be met if the fundamental **conditions** are present, that is, **external business organisations** (companies and firms) can further **take advantage of the current financial opportunities**, the economic environment will improve and the national economy will grow.

Conditions determining potential growth are the initiation of **changes** in the university's current complicated and unjustified system of monitoring and **regulation,** as well as establishing clear-cut lines of responsibility and authority

Developing a new, more **enterprise-friendly approach** that will promote businesses and an improved organisational system at the university is of utmost importance. In addition, **strengthening the available research and development innovation organisations** and establishing and supporting new spin-off companies that promote utilisation is another condition. There is not likely to be any increase in revenues without introducing **actual and transparent cost accounting**. An entirely new operational and entrepreneurial background and set of conditions need to be established.

The regional impact of the project also has to be taken into account, since opportunities and synergies allowing efficiency growth in resource management and continuous improvement in energetic efficiency are to be identified at regional level.

Objectives and Tasks of Geo-Information Processing Scientific Workshop

The research areas of the scientific workshop, especially mineralogy, petrography and geography, face intense competition both nationally and internationally. Departments involved in the work of the scientific workshop are in a favourable competitive position; they enjoy excellent international relations, which has enabled them to take their place in the international professional community. The available equipment and instrumentation (due to developments going on for decades at the Faculty of Earth Science and Engineering and participation in major projects) are competitive and in some areas even state of the art. An excellent leading researcher who is familiar with international trends and system of international relations supervises developments in the field of GIS at the Department of Geodesy and Mine Surveying. Researchers of the Department of Geophysics conduct research into more general geo-information phenomena, whereas colleagues at the Institute of World and Regional Economics deal with research on economic issues.

Research areas and objectives are as follows:

- to obtain and expand geo-information by developing methods for specifying direct material and physical characteristic parameters in geological, mineral and rock research in order to meet the workshop objectives.
- to process data and information and to further develop the interpretation of implicitly existing geo-information in the data (inverse method development), which is based on the related international scientific achievements and belongs to the principle direction of the research. The workshop researchers have achieved outstanding results in elaborating a unified version of processing and interpretation of data belonging to different data systems and in developing discretisation methods allowing more accurate and explicit interpretation of geo-information formulated in the data. Continuing research in this area is an objective of high priority.
- As for research into GIS, the main direction and objective is to develop general and free-access GIS systems, to analyse basic systems of GPS positioning and GIS-aided mining applications.

- Ensuring access to the latest theoretical and practical scientific achievements to researchers involved in research into economic geography at Miskolc University is also of strategic importance, since in this way they can retain and enhance their competitiveness. In order to meet this objective it is mandatory to continue to improve access to technical literature and data resources, to develop the IT infrastructure, to participate in research projects and to take an active part in conferences and major forums.

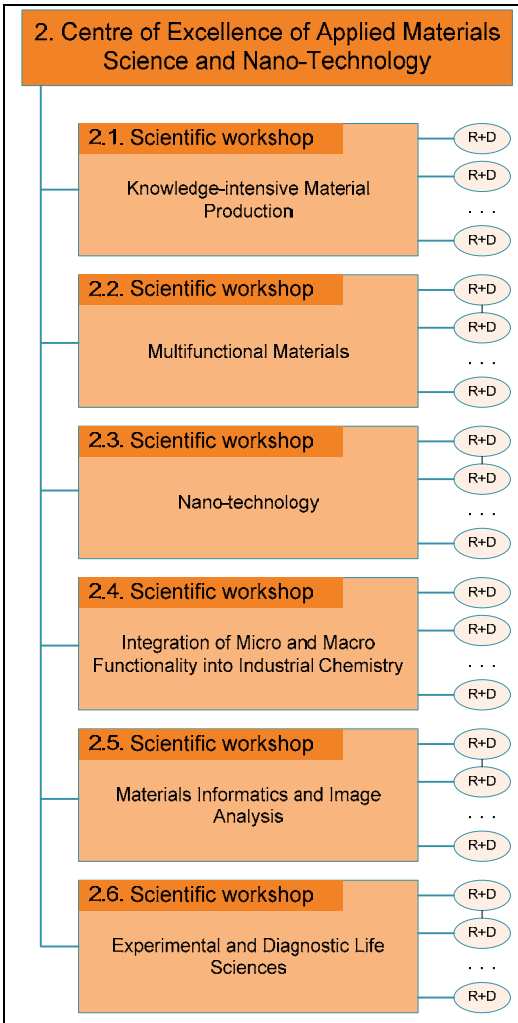
In order to meet these objectives, intensive publication activities are of utmost importance. In accordance with its publishing practice up to now, the workshop aims at publishing as many scientific articles as possible in international journals (primarily those with impact factors).

Ways and systems of quality development of project plans and research areas of high priority, applied to meet the set objectives

The identified research areas and the methods applied are recognised internationally, since workshop researchers maintain intensive international collaboration with leading research schools, which provides a foundation for improving research and development work. The set plans related to research require high performance that meets international research standards. This includes publication of the undertaken technical articles primarily in international technical journals (with impact factors, where possible) while the TÁMOP project is being carried out and continued. The tool system of the objectives involves the accumulated workshop experience and infrastructure.

2-year objectives:	Execution of the set tasks and assisting at least two PhD students to the stage of submitting their dissertations
5 -year objectives:	Execution of the tasks set in the continuation stage. Workshop involvement in a major international project and enhancement of international relations
10 -year objectives:	Further workshop work, successful generation change, participation in major international projects and enhancement of international relations

6.2 Centre of Excellence of Applied Materials Science and Nano-Technology R&D strategy



Budget of CE: 427.7 million HUF

Director: **Dr. Roósz András**, HAS Member

Number of scientific workshops: 6

Number of researchers involved: 111

Number of new staff: 25

Number of PhD students involved: 18

Situation analysis

The transformation of European industry into a knowledge-intensive one is essential in order to enhance its competitiveness. Developing materials with new properties plays a crucial role in this process and lays the foundation for technological advancement in a number of areas. The primary aim of the project is to participate in major international research and development grant projects in the field of **materials science, materials informatics, nano-technology and nano-toxicology**, to apply state-of-the-art scientific methods, processes and experience. Objectives of high priority are acquiring more extensive knowledge about materials with unique properties and researching materials with customer-tailored and predetermined characteristics in **multifunctional materials and knowledge-intensive material production.**

The scientific workshops are as follows: Knowledge-intensive Material Production, Multifunctional Materials, Nano-technology, Integration of Micro and Macro Functionality into Industrial Chemistry, Materials Informatics and Image Analysis, and Experimental and Diagnostic Life Sciences.

Composites, the advanced multifunctional materials of the 21st century, differ from conventional materials such as metals, ceramics or plastics, which often fail to meet the increasingly specialised requirements. The application of composites (or combined materials) in engineering practice is continuously expanding. They can be applied for a number of purposes, since the properties of the constituent materials can form special combinations. In addition, these properties can be varied (in a predetermined way depending on the composition) by production technologies. Material properties can further be improved by surface technology, whose R&D&I areas encompass a number of segments of product production, renovation and maintenance, starting from production/manufacturing to the recycling of worn final products, which results in **knowledge-intensive material production**.

The North Hungary region is the centre of plastics raw material production in Hungary, since it is the place where raw materials for PVC, polyolefin and polyurethane are produced. Consequently, the region can boast of its plastics processing industry as well. The production development of plastic raw materials rarely takes place beyond the boundaries of the production plant; the applied technology (recipes) and the processing are not particularly concentrated activities. For development purposes it important to know and optimally design the composition, the structure and the properties of materials. Researchers can undertake this activity and also bring in income to research institutions. This is the reason why there is a need for the **integration of micro- and macro functionality into industrial chemistry.** This model has found its application in the universities of nearby countries, such as the Austrian universities of Leoben and Linz and the University of Košice in Slovakia. Since universities and research institutes cannot satisfy the increasing demand of the whole industry for research, they have begun specialising in particular areas. About 80% of the research into polymer nano-composites is conducted outside industrial research laboratories, primarily due to its knowledge-intensive character. However, some industrial research laboratories have achieved con-

siderable results; for instance, Kabelwerk Eupen AG in Germany has developed fire retardant premium cables.

The **Experimental and Diagnostic Life Sciences Scientific Workshop** aims at strengthening life sciences and biotechnological potential at the University of Miskolc. Education and research tasks of engineering and life sciences have started to merge. Since there is no university for training doctors in Northern Hungary, the Faculty of Health Care plays a key role not only in the training of health care specialists but also in conducting research into new and applied life sciences. The region is in an unfavourable position regarding such research compared to other regions of Hungary; thus, this research requires substantial funding. Both the short- and mid-term strategic objectives include conducting research into human life sciences (the Academy's responsibility) and the introduction of new therapeutic and diagnostic procedures.

SWOT analysis

CE strengths	CE weaknesses
- Applied materials science and nano-technologies are undergoing dynamic development. They are one of the high priority areas in the EU's Seventh Framework Programme. - Some areas can boast outstanding researchers. - Research infrastructure and equipment in some areas is very advanced. - The complex laboratory of image and structure analysis is considered to belong to strategic research infrastructure. Important international relations have been developed. - A considerable number of young researchers are involved in research in some areas. - Scientific performance is higher than the university average. - The only research group of the Hungarian Academy in this university operates in this CE - It is *multidisciplinary*. - Scientific evaluation has been excellent. - Many-sided training (chemical engineers, chemists and material engineers) is involved. - We have skills in special polymer physics measurements (TSD).	- There are industrial disparities in particular sub-areas: in the Northeast region there is a strong industrial background in the field of industrial chemistry, but in the field of knowledge-intensive material production and multifunctional materials the industries are geographically distant. In the field of nano-technology the industrial background is poor. - There is a shortage of young researchers in plastic deformation, nano-technology, casting and surface treatment. - In several areas there is a lack of *material expenditure* for research.
CE future opportunities	**CE future threats**
- Improving the labour force by attracting young workers to the North Hungarian region from other regions or from abroad. - Participating in major international co-operation and research funded by the EU. - Increasing revenues by launching various activities and by operating advanced equipment efficiently. - Increasing the complexity of the research work and tighter collaboration in particular sub-areas. - Increasing uncertainties in research funding, are frequent and changes in their content and form are unpredictable. - Expanding physical measurements of special polymers. - Expanding plastic processing techniques (extrusion, foil blowing, heat shaping, compounding). - Attracting new industrial customers.	- Low retaining attraction of the NH region and emigration of young researchers from the region - Low social prestige of engineering education and research. - Complete lack of industrial background in particular sub-areas (nano-technology). - Lack of financial resources for operating state-of-the-art equipment and instrumentation. - Strong attractive force of the industry for well-qualified workforce (leaving academia). - Cancellation of purchasing in particular areas.

The development strategy of the CE research areas

Objectives and tasks of particular scientific workshops are as follows:

- **to become domestic market leaders in knowledge-intensive material manufacturing, casting, multifunctional materials, surface treatment and industrial chemistry** and to deliver high performance in international scientific forums.
    - to develop intensive deformation within knowledge-intensive material manufacturing and to include this in a high-priority area: to survey regularity in grain refining impact during thermo-mechanic cyclic deformation by physical simulation, to develop rolling modelling programmes using Maple, Matlab and Finite Element Analysis programs, to conduct semi-plant-scale experiments for rod-like material production and plant-rolling experiments.
    - to participate in research into materials science and materials technology related to electronics spare part production, soldering and brazing technology in order to meet increasing needs of the automobile industry and to regard this as high priority objective of the Multifunctional Materials Scientific Workshop
    - to provide priority to **polymer technology** in the Multifunctional Materials and Materials Technology Scientific Workshops. Dynamic mechanical analysis, a key method of measuring polymer characteristics, ensures great opportunities for achieving new scientific results, which are particularly promising in the field of complex polymer systems. Consequently, polymer blends, alloys and materials with special structures like gradient materials belong to key research areas.

Execution plan of high priority research areas of the Centre of Excellence targeting raising financial resources:

- to ensure financial support for operating the 'Complex Laboratory of Image and Structure Analysis' listed in the National Research Infrastructure Register;
- to continue the MICAST EU research programme;

- to improve infrastructure and human resource conditions of the research group attached to the Hungarian Academy of Sciences (HAS);
- to apply for funding from the Hungarian National Fund for Science and Research (OTKA) in the field of intensive deformation;
- to encourage young researchers to apply for the Bólyai Research Scholarship and to prepare and submit projects to the Hungarian National Fund for Science and Research (OTKA);
- to elaborate and sign a collaboration plan with major industrial companies valid for several years;
- to develop basic and applied research in nano-medicine
    - to develop drug carriers and nano-toxicology;
    - to conduct studies in cellular therapy and banks and to develop related services;
- to elaborate complex preventive and rehabilitation services.

R&D&I objectives

The objective of the Centre of Excellence of Applied Materials Science and Nano-Technology is to fulfil the indicators undertaken in the project within two years, that is, an increase in the number of researchers, educators, PhD students and bachelor and master students involved in the project. Other objectives are to submit patent applications that are outcomes of the funded projects of high priority; to prepare educational supplementary materials and to create new positions; to encourage students to write theses, dissertations and SRS academic papers related to research areas; to publish articles related to the research areas in national and international technical journals; to write national and international monographs; to participate in conferences and have findings published in conference proceedings.

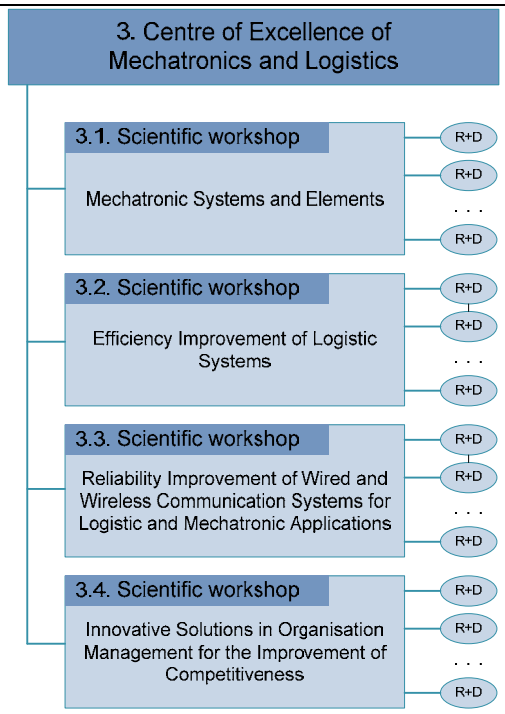
Dynamic development is expected at the Department of Theoretical Health Sciences, in the Faculty of Health Care of the University of Miskolc. The Department of Nano-biotechnology conducts research into liposome drugs. The on-going projects will provide excellent infrastructure and human resources for the research, which will meet all the demands regionally and in some areas even nationally. The research group will be capable of developing nano-pharmacological and liposome drugs, of providing physical,

chemical and in vitro biological characteristics of nano-materials and of conducting nano-toxicity examinations.

Major impacts of the CE research work:

- expenses related to the operation, maintenance, service and development of the research infrastructure may be partially covered,
- the role of the CE is likely to increase in national and international scientific life,
- the activities of bachelor's and master's students and PhD students will be more oriented towards solving practical problems,
- the most outstanding scientific achievements will be incorporated into education,
- the CE will be able to provide a complex R&D service to its industrial partners and increase the probability of new patents being awarded as an outcome of the research project,
- the number of students successfully participating in national conferences organised by the Students' Research Society and in thesis competitions will increase.

6.3 Centre of Excellence of Mechatronics and Logistics R&D strategy



Budget of CE: 470.8 million HUF

Director: **Dr. Illés Béla**, professor

Number of scientific workshops: 4

Number of researchers involved: 122

Number of new staff: 6

Number of PhD students involved: 8

Situation analysis

The Centre of Excellence of Mechatronics and Logistics (hereinafter: CEML) aims at implementing an integrated system of objectives and has undertaken the mission of bringing together and collaborating with departments and research workshops addressing scientific areas that undergo the most intensive technical development, achieve a spectacular growth in major branches of the industry and whose production accounts for 12-21% of the GDP.

The R&D activities were conducted on direct requests initiated by industry until 1990, which resulted in a very efficient collaboration of the university and industry. This form was assisted by projects targeting specific areas (G6, C15), HAS, the Hungarian National Fund for Science and Research (OTKA) and the National Committee for Technological Development (OMFB). Later, different forms of cooperation were introduced and Cooperative Research Centres and Regional University Knowledge Centres were established. CEML departments also participated in their work. In the last decade the launched EU Projects (NFT I, ÚMFT) provided new fundraising opportunities, and a

considerable amount of infrastructural development (buildings, devices and machines) promoting R&D activities was carried out.

Research and development of mechatronics systems and its elements

Advanced computers are extremely complicated mechatronic devices and their building requires many-sided knowledge and extremely accurate production skills. Actors working in the tool industry have started specialising in particular areas and a division of labour has been established. The Department of Machine Tools of the University of Miskolc, taking advantage of its previous and current experience in design, is capable of carrying out the development of precision machine tool production capacity to meet special industrial needs.

In the fields of electrotechnical engineering, industrial electronics and measurement, the objectives of the R&D areas of high priority are as follows: research into electric subelements of renewable energy resources, measuring methods of increasing energy efficiency, smart metering, smart grids, environmentally-friendly systems of power electronics, such as LEDs and LED drives.

The mission of the Mechatronics Scientific Workshop is to provide R&D support to industrial companies in the region and to ensure the supply of required experts. Mention should be made of competitors with the same profile who operate outside the region: Budapest University of Technology and Economics (BME), Óbuda University, Széchenyi István University and the University of Pannonia. On the other hand, these universities are also our partners in co-operation activities.

Our major university partner is the Department of Mechatronics, Duisburg-Essen University, with Prof. Dr. Schramm, the head of the department. The most important industrial relations are: the Bosch plants located in Hungary, Szimikron Kft, NCT Kft, Elmű Nyrt and Émász Nyrt.

A Robert Bosch Mechatronics Department was established at the University as a result of the fruitful collaboration of the University of Miskolc and the Bosch companies operating in Hungary. A close collaboration was developed with several other companies.

The state-of-the-art laboratories of the department highly contribute to practice-oriented teaching and supplying a highly qualified regional workforce.

In addition, the on-going TIOP investments have considerably changed the research conditions of the Mechatronics Scientific Workshop, both on the scale of research instrumentation and infrastructure.

As for electrotechnical engineering and electronics, the University suffers from limited financial resources, but due to active participation in R&D, these areas have become leaders in a few specific research topics. Although the workshop started its activities in the field of renewable energy resources and the development of their elements rather late, it was soon able to obtain the required human resources and equipment capacity for attaining energy efficiency and reducing the electric energy consumption of new technologies.

The Department of Physics can boast of considerable research potential in the field of experimental nuclear physics and theoretical solid-state physics,, which has developed in the past few decades. The developed electrospectrometric system, which includes a high vacuum system and a measurement and data collecting system, is unique in the region. The identified research directions fit in with international research trends in physics and provide opportunities for publishing papers in impact-factor journals.

Research into efficiency increasing procedures and methods of logistics systems

The application of highly intelligent and fully automated systems has been gaining pace in production, and in local and global systems of logistics. These systems apply the most advanced designing, test and diagnostic procedures and virtual elements used for designing machines, systems and control. The Internet data traffic is closely related to actual material processes (e-commerce and virtual systems) and the application of advanced product and vehicle identification systems (RFID, GPS, etc.) have found widespread usage. Apart from vehicular traffic networks, various functional networks have been established recently. Along with focusing on quality assurance and accurate scheduling of product supply while meeting the Just in Time (JIT) requirements, special

attention is to be paid to developing systems serving in-company product supply following the principle of highly efficient stock management and to elaborating methods ensuring a flexible shift. The robotisation of workplace services and the simplifying of preparation work require advanced design processes, testing and control. The system complexity requires the development of modelling procedures, applying simulators and virtual robots to assist with the design work, and establishing efficient management.

In the field of logistics the Department of Materials Handling and Logistics can be considered to be a leading research and developing institution within Hungary. Széchenyi University in Győr, Szent István University in Gödöllő, the Budapest University of Technology and Economics as well as the University of Debrecen also provide a considerable basis for research and development. Small groups at engineering departments and institutes of numerous colleges are also involved in R&D. They are both competitors and collaborators, who work on projects either in consortium or in another form. Foreign institutions with similar profiles (universities in Dortmund, Trnava, Magdeburg, Košice, Cluj-Napoca, Belgrade and Graz) tend to be cooperating partners rather than competitors. Our primary competitors can be considered to be design, development and consultancy companies operating on a market basis.

Since the Department of Materials Handling and Logistics has developed fruitful collaboration with a wide range of partners on a national and international scale, it can offer a background of successfully completed projects that can be advantageous in its future work. The department runs an open policy and acts as an integrating player, since it collaborates with experts in informatics, automation, telecommunications and electronics and conducts negotiations with representatives from the field of economics, law and humanities. TIOP and OKM projects provided substantial resources to the department to build a laboratory for product identification, high-tech and robotics where research into logistics, automation and communication is carried out. The laboratories are capable of presenting international state-of-the-art equipment. The establishment of the laboratory of virtual modelling has presented new opportunities.

Increasing reliability of wired and wireless communication systems in logistics and mechatronics applications

In the field of CE research related to machine production algorithms, and especially in the area of workshop-level production planning tasks, the development of GPGPU-based massively parallel algorithms has opened up a completely new direction on an international scale. The novelty is of two levels: on the one hand, it is manifested in elaborated new principle-based planning algorithms, on the other hand, it utilises the opportunities of paralleling that are hidden in applied local searching techniques.

The developing intelligent AGV-based transport devices open the door to new trends in logistics and mechatronics systems. Expanding system-based integration (logistics, IT, communication and automation) is a great challenge of the research into applied industrial logistics systems.

Current challenges are the introduction of telediagnostic systems in freight and passenger transportation, the expansion of industrial communication techniques related to mobile communication and product identification, and the development and spreading of functional security methods in the field of mechatronics and logistics on a large scale.

The University of Miskolc has taken a national lead in teaching logistics and mechatronics and conducting research in this area. It has a strong industrial background (Bosch, Jabil) and international, mainly German, collaborations. The completed infrastructure developments funded by TIOP and TÁMOP projects also contribute to the strengths of the university. Taking into consideration the above-mentioned situation, it can be claimed that the R&D conditions at the University of Miskolc are outstanding within Hungary.

Innovative solutions in organisational management with the objective of increasing their competitiveness

The concept of ‘the learning organisation’ often emerges in different contexts. The learning organisation is not established by itself. In order to evolve and to exploit the

opportunities hidden within, there is a need for a consciously elaborated and fully executed learning strategy. One of the fundamental elements of company success in a competitive market is the extension of the unique and distinguishing knowledge the company has acquired from different areas of an established and operated production or a service. The related research conducted by the Faculty of Economics processes and systematises the projections of knowledge management, innovation and technomanagement, organisational development, organisational behaviour, company management and marketing.

SWOT analysis

CE strengths	CE weaknesses
- Well-equipped laboratories are available. - The laboratories contribute to development and are suitable for providing services and training. - Broad industrial relations on a national and international scale. - Efficient incorporation of research results into teaching. - Highly experienced managers and numerous successfully completed projects. - Opportunities to attract talented students and to involve them in research work.	- Unfavourable age pyramid, aging academic staff. - Lack of the qualified electrical specialists required for mechatronics. - Poor publication activities and low number of citations received - Low number of staff with scientific degrees - Lack of skilled laboratory workers - Bleak prospects for industrial collaboration and R&D - Research often taking place within the framework of private companies. - Lack of industrial collaboration in numerous areas - Unsatisfactory international relations - Lack of performance evaluation on an institutional scale. - Lack of knowledge-transfer forums. - Researchers are not aware of the need to gain income from outside sources
CE future opportunities	**CE future threats**
- Increase in research potential and its efficient exploitation. - Research services can become a pulling force. - The circle of young researchers may expand. - The number of industrial collaboration, especially with SMEs, may considerably increase. - High priority areas may stand out and their involvement may strengthen. - The number of scientific degrees and the amount of academic potential can increase. - Conditions for participation in international projects can be established. - Collaboration between departments will improve CE. - Conditions for operating laboratories involved in practical education can be established. - Faculty competitiveness will improve. - New international relations will be established. - Conditions for participation in European projects after 2013 can be established.	- Cuts in funding higher institutions make operation in particular areas impossible. - Uncertainty due to the lack of guaranteed research career models. - Development of the economic environment of the region - The purchased machines and instrumentation are not efficiently utilised. - University competitiveness on the knowledge market may decrease. - University fails to meet the challenges of the business sphere. - Lack of human resources will lead to emigration of talented young people. - The university may suffer losses the competition in higher education, which may be heavily sanctioned by the new act.. - The determining staff may lose enthusiasm. - The attraction of the business sphere makes finding replacement in researchers impossible.

The development strategy of the CE research areas

The fundamental objectives of research places and departments involved in CEML are in line with the system of objectives in which the University of Miskolc has the goal to be awarded the title of Research University. The aim is to achieve research results that comply with international trends and enhance the competitiveness of the University. Their elaboration improves the quality of the human resources, ensures a higher academic rank and improves publication activities and the quality of scientific papers complying with international standards. The elaborated procedures and outcomes provide a basis for sustainable growth in the duration period. The workshop organisations pay special attention to successful industrial exploitation of the achievement and focus on income-generating capacity (offering research services). The organisations are not planning to physically integrate the laboratories. However, they are thinking of utilising an integrated collaboration in particular topics of research. The project developers are striving to create favourable conditions for establishing companies on the developing basis of the infrastructure within the framework of the incubator house with the objective of creating job opportunities for talented graduating students, which follows the concept of the 'incubator house' and utilizes the workshops in Building C/2. Retaining our graduates in the region is an important social mission, and to carry it out there is a need to increase the number of professional jobs.

Research and development of mechatronic systems and elements

In the field of logistics, mechatronic automation and complex diagnostics, efficient handling, operation and control of equipment require the application of intelligent systems. Complex research of these areas and the industrial application of the achieved results are essential. The objective is to attain that the third CE enables the University of Miskolc to win the status of Research University and to retain this title.

The projected main directions of research are as follows:

- providing a basis for developing the production capacity of a precision machine tool with a view to meeting special and supplementary industrial needs
- developing electrical sub-elements for renewable energy resources in electronics, industrial electronics and measurement techniques.

- elaborating a smart grid and efficient and environmentally-friendly power electronics systems, focusing on measurement methods and increasing energy efficiency.
- collaborating with the Bosch group in further developing starter motors and commonly participating in R&D projects.
- developing an electrospectrometric system, a high vacuum system and an electron gun while elaborating measurement and data collecting systems

The mentioned activities in the field of mechatronics are key components of the publication of scientific articles and PhD dissertations, the identification of innovative solutions and the incorporation of their results into teaching. While improving the research laboratory infrastructure and purchasing very advanced software, special attention should be paid to facilitating the research potential. The achievements attained in mechatronics enhance the opportunity to win R&D&I projects in the future, resulting in raising money for operating the well-equipped laboratories for service purposes. However, a considerable increase in R&D revenues can be attained only if the cuts in the university budget do not threaten the competitiveness of the university.

In order to achieve the set objectives it is indispensable to perform planning in human resources policy, to improve the unfavourable age pyramid, and to develop the technical staff required for operating the advanced laboratories and workshops. A life career model should be created which does not adversely affect the proportion of scientific qualifications.

The Department of Material Handling and Logistics, in collaboration with the Department of Descriptive Geometry and the Department of Mathematics, carries out developments in intelligent logistics systems, and within this, in equipment (machines) and technologies (warehousing and commissioning), applies modelling and testing procedures to test operational systems, and carries out simulation tests of systems. These methods allow us to optimise the material flow in the logistics system, analyse planned systems, set parameters of operation tests and perform impact analyses.

Predictable main research directions are:

- elaborating suitable methods for improving the operating efficiency of intelligent and highly automated systems and applying these methods in-company and in the regional and city transportation logistic systems.
- Further developing modelling and simulation testing procedures suitable for operation control and production scheduling and utilizing the results by optimising the system parameters, conducting environmental impact analyses using Audi Hungária Motor and Guardian Kft. as references.
- The introduction of the Galileo identification system in Europe enables logistics systems to exploit new identification opportunities: application of advanced product identification systems, conducting suitability analyses of telecommunication and automation devices (RFID and product identification systems).
- laying the foundation for the establishment of a virtual logistics company and centre in the regions near the Slovakian, Ukrainian and Hungarian borders.
- enhancing work on establishing a standard logistics terminology in line with EU practices and continuing to conduct comparative language research.
- developing integrated logistics management systems paying special attention to reducing unfavourable environmental impacts, establishing a closed-chain economy, exploiting resources more efficiently and improving the living standard.
- establishing conditions for granting shared German and Hungarian degrees after completing studies and training in logistics.

Objectives:

- participating in developing advanced production and supply logistics systems by applying developed methods,
- developing the department laboratories and using the intelligent elements of the available systems (sensors, controlling units and so on) to meet the specific modelling needs of industrial and service provider sectors.

The two goals to be followed in the research work of the department are as follows:

- that the chosen research topics help the academic and research staff win scientific degrees and increase publication activities,
- that special areas of department activity become competitive and the generated income can be invested in maintaining the achieved potential.

Research activities should have a favourable impact on educational development, establishing an advanced practical background for introducing new forms of education and promoting advanced teaching methods (virtual laboratories). The department, together with the actors of the business sphere, should examine the opportunities and ways for exploiting methods elaborated in the project. It should also strive to collaborate with other research institutions and jointly undertake complex tasks.

The on-going TIOP project contributes to developing the department laboratories. It is important to elaborate plans of research to be conducted in the laboratories and to involved students working on their theses and SRS papers.

The condition for quality improvement is to expand human resources by employing experts with adequate skills in specific areas. The operation of an up-dated laboratory infrastructure requires technicians. The systems established by development cannot be maintained and operated with the objective to provide income-generating services without R&D operating income.

The developments funded by the project generate R&D activities; however, the staff also require encouragement. Laboratory sample systems would allow us to organise special training courses (pharmaceutical), which can generate considerable income. An adequate marketing policy (promoting companies) can result in an increase in the number of sponsors. Income can also be generated from successful participation in projects (within the framework of the Széchenyi Terv the department and two or three major logistics companies (BILK, ATI DEPO, Waberer Kft.) are planning to jointly apply for projects).

The virtual laboratory can be utilised if courses are organised where the new systems are taught. The achievements can be exploited by industry through the university knowledge transfer organisations (TTC, UNI-Flexsys).

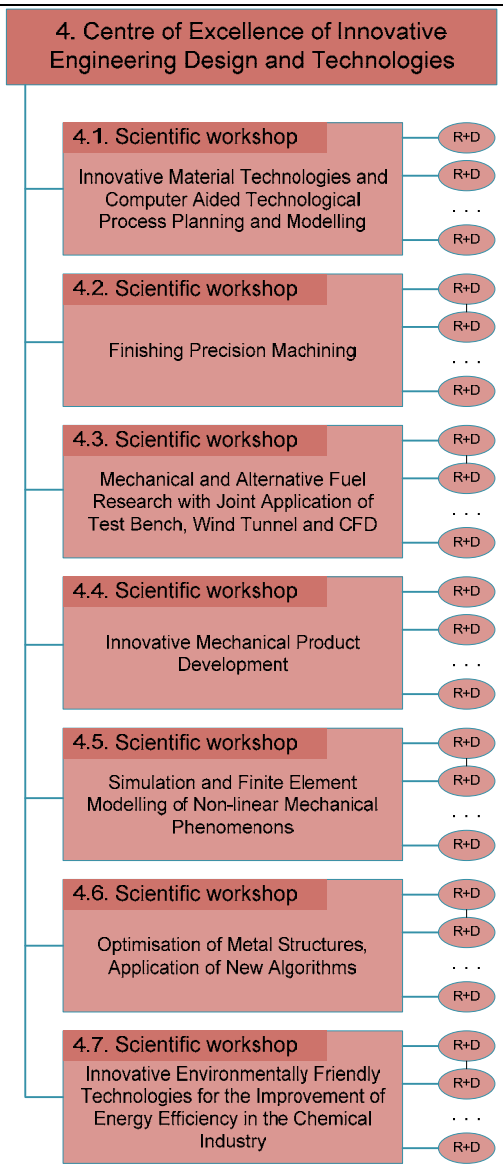
Increasing reliability of wired and wireless communication systems in logistics and mechatronics applications

This workshop involves participants from automation and industrial communication and the following departments: the Department of Automation and Communication Technology, Department of Analysis, Department of Information Technology and Department of information Engineering

The main directions and topic areas of the workshop are:

- R&D activities are related to topics of logistics and mechatronic character,
- developing intelligent AGV systems ,
- conducting research into applied logistics systems, identifying needs in airport, commercial, medical, warehousing, passenger transportation, agricultural, manufacturing models, control techniques, identification techniques and communication techniques and elaboration application hardware and software,
- development of telediagnostic and safety systems for mechatronic and logistics applications.

6.4 Centre of Excellence of Innovative Engineering Design and Technologies R&D strategy



Budget of CE: 332.6 million HUF

Director: **Dr. Jármai Károly**, professor

Number of scientific workshops: 7

Number of researchers involved: 86

Number of new staff: 5

Number of PhD students involved: 12

Situation analysis

After the evaluation of **materials science developments** going on in the past 40-50 years and belonging to the research area of the Scientific Workshop of **Innovative Materials and Materials Technologies** it can be claimed that after the appearance of micro-alloyed steel in the 1970s, a completely new material type emerged every fifth year, which fundamentally changed sheet forming in the car manufacturing industry and had a considerable impact on technological developments. The so-called dual-phase steels and various types of high-strength steels (HSLA, isotropic steels, TRIP, TWIP, X-AHSS

and U-AHSS steels) are achievements of the utmost importance in materials development. Apart from developments in steel, aluminium alloys – belonging to non-ferrous metals – have undergone enormous changes. The application of new materials in production forming technologies also leads to substantial changes and developments. These changes are experienced in the whole process of the automobile manufacturing innovation chain, starting from raw material production through processing and different treatments to final sheet shaping processes.

In the Scientific Workshop of **Innovative Technologies** the main objectives are the analysis and development of three priority areas of materials technologies (welding, heat and surface treatment, and plastic deformation). A more detailed description of these technological areas is given below.

Welding can be considered to be the most important metal-joining process both in our every day life and in perspective. Currently, welding faces two challenges: the spread of thin sheet constructions and the application of high-strength steels and aluminium alloys elaborated and developed in the near past.

The pressure or fusion welding of thin sheets gives rise to problems that were not experienced in conventional or thick sheet welding. Researchers are working on various variants of processes and technologies (impulse welding variants) which, by utilising an advanced technical background, can be applied in regions with light structure manufacturers and in new emerging plants. Thermo-mechanical, precipitation-hardened and heat-treated variations of high-strength steels (normalised or tempered) can be considered – from the point of view of material structure – as an unstable material that shifts towards a stable state when heat is injected. Consequently, neither their thermal cutting nor their welding can be performed under the conditions used previously. A periodic energy input allows the heat dissipation of heating to be kept in the right hand, reducing deformations and stresses and reducing or preventing material structures from deteriorating. The workshop possesses the resistant welding machine and gas metal consumable electrode arc welding machines required for research and development activities. The research work is supported by SYSWELD program package. This research point is closely linked to the 4th R&D topic of the first scientific workshop.

Heat and surface treatment: materials technologies of the past decades are characterised by the rapid development and implementation of extremely varied processes aiming at changing structures, quality and properties of surfaces and surface layers. Another group of factors promoting the development of advanced surface technologies encompasses advanced materials science knowledge, test methods supporting materials research and broadened opportunities resulting from tools development providing technological solutions.

Both advanced surface engineering and surface technology have become interdisciplinary special fields with new and complex approaches only in the past few decades. The term 'surface engineering' as used in the English technical literature encompasses all engineering activities – from planning through production to quality assurance, application conditions and impact testing – that have a favourable impact on application properties and life span of industrial products, structures and machine parts.

Plastic deformation is one of the most material- and energy-efficient procedures in metal processing. Plastic deformation, especially sheet formation, is heavily applied in the automobile manufacturing industry; consequently, it is the car industry that is a key driver of its development, with special attention to reducing car mass. Since vehicles have to meet safety requirements, there is an increasing demand for the application of high strength materials. However, when the strength is increased, the formability of materials decreases. In addition, formability plays a key role in the production of body elements. Consequently, the proper balance has to be established in this controversial issue.

Sheet hydro-forming, laser forming, hot and semi-hot forming, super plastic forming, incremental forming, comprehensive computer-aided design and modelling of technological processes, monitoring and intervention are the key issues that are worth mentioning when speaking about sheet formation in the car industry.

The main research direction of the Scientific Workshop of **Precision Finishing Treatment** (production engineering) is to increase the lifespan of parts built into products (by improving the quality and the accuracy of processed surfaces) and to

improve product reliability. This is the reason why research into precision finishing processing is of high priority in machine processing. The objective of the research is to enable abrasive resistance and quality to meet the requirements alongside with a constant increase in economic efficiency and decrease in the environmental burden.

As for research into **machines and alternative fuels,** considerable improvement has been achieved in the development of the infrastructure and pool of instruments due to TIOP and TÁMOP projects. Utilisation of these opportunities is an important objective, which requires the appropriate human resources and their adequate motivation and training in order to utilize the potential opportunities. Since the tasks are complex, the current compartmentalised infrastructure shall be eliminated; real and virtual integration both within the faculty and among faculties shall be established.

The topics researched by the 4CEs – 4SWs in the field of i**nnovative machine design** are in line with international trends. In toothed gear pairs special attention is paid to asymmetric teeth in unidirectional drives (vehicle manufacturing industry and special drives) and especially to geometrical, production, strength and dynamic issues. In the field of applied materials emphasis is paid to plastic materials (with special additives) with non-cutting technology solutions that do not have adequate design support (hand tools, small machine and micro-drives). Numerous studies are being conducted into compact drives with high gear ratio (harmonic drive) in the USA, Japan, and Russia and at BME in Hungary. Integrated product development is performed in Germany, Sweden and the USA with special attention to environment protection and recycling, which are closely linked with natural resources management. Thus, optimisation and elaboration of planning directives and their methodological execution also play an important role.

The main research topics of the Scientific Workshop of **Non-Linear Mechanical Phenomena Modelling and Finite Element Simulation** encompass the increasingly realistic modelling of engineering processes resulting from the range of flexible deformation and high deformation permanent set and finite element simulation.

International trends in the main research topics of the Scientific Workshop of **Optimal dimensioning of metal structures** within **structure optimisation** are as follows: as

the importance and the expenses of basic research increase, very intelligent research software kits are developed, and there is a considerable shift from the previous physical modelling towards numerical modelling. The importance of physical and laboratory modelling remains, but their main objective is to confirm the computational results.

In the Scientific Workdhop of Development of Innovative Environmentally Friendly Technologies and Increase of Energy Efficiency the main research areas that are in line with international trends are as follows: to develop environmentally friendly chemical technologies and to establish and to develop a synergy between waste management and an increase in energy efficiency.

Computer-aided engineering methods are heavily applied in the every-day activity of all workshops of the 4th Centre of Excellence. Computer aided design and production have undergone meaningful development, especially in the application of CAD/CAM systems that have become fundamental requirements in the supply sector of industry. Three-dimensional geometric modelling and cut-edge automation of design processes have become a general practice in CAD/CAM systems. As for development, tailor-made modules are gaining popularity in various technological areas. These modules encompass the whole chain of a particular technological process starting from designing a prototype through detailed technological process planning to quality assurance and quality management (product quality planning)

As for computer-aided engineering, finite element simulation has become a priority area in process modelling and a more realistic simulation of processes.

In the scientific fields of the current R&D strategy the University of Miskolc plays a determining role on a national scale; however, critically speaking, its weight and importance have decreased in most areas. As for the reasons on a national scale, mentioned should be made of the compartmentalised higher education system and strong political intervention, which appears in supporting forms and mechanisms that fail to reflect the actual financial situation. The lack of an accepted and clear-cut research and science policy reflecting international research trends is another unfavourable factor.

Apart from external factors, mention should be made of the lack of a comprehensive research concept on the university scale as well.

Despite these unfavourable tendencies, the University of Miskolc has attained some degree of international recognition in several areas; however, this is mainly due to previous achievements and not necessarily to its current performance. Similar to the national political and economic situation, the University of Miskolc failed to benefit from its considerable competitive situational advantage that offered enormous opportunities due to previous achievements and position and that was accompanied by social changes in the Central and Eastern European region. By this time the country and, unfortunately, the University of Miskolc have suffered considerable losses both in weight and role. Currently the country is mentioned among backward countries of a region that is lagging behind.

SWOT analysis

CE strengths	**CE weaknesses**
- Experienced, recognised, older academic and research staff - Relative national and international recognition - Currently existing and partly operating national and international relations - Currently relatively stable industrial relations and a wide collaborative background	- Lack of young academic and research staff - Complete lack of financial resources - Failure of resource planning - Obsolescence of some instruments - Activities of low efficiency and high red tape - Waste of resources due to lack of concepts and strategic decisions - Low degree of utilisation in some cases
CE future opportunities	**CE future threats**
- Looking for resources from projects - Successful project activity - Promotion of industrial and economic relations - Strengthening international relations - Favourable internal and external impact of the work in the Centres of Excellence - Research activities supported by industry - Increasing number of scientific degree holders and favourable external and internal impact due to received support	- Age gaps - Lack of experienced young professionals - Attraction of the business sphere, especially among young researchers - Uncertainties in higher education - Macro- and microeconomic uncertainties in industry and in the institution

The development strategy of the CE research areas

The seven scientific workshops operating within the fourth Centre of Excellence (Innovative Engineering Design and Technologies) conduct comprehensive research. The main elements of objective and directions are summarised below.

The fundamental objectives arise from the character of the Scientific Workshop and take into consideration the formulation of the comprehensive objectives and compilation of the research plan of the Scientific Workshop. These objectives are to cover scientific areas of the workshop as broadly as possible, while conducting scientific activities in specific areas as deeply as possible, thus enabling the scientific workshop to become recognised in a particular area on a national or even an international scale. This concept provides for attaining comprehensive professional knowledge, making research results available, ensuring conditions for performing entrepreneurial activities on a wide professional scale, establishing scientific schools in particular professional areas, gaining access to new scientific achievements and obtaining the PhD degree required for a cutting-edge education. **The aim of the CE is to comply with the criteria required to obtain the status of university within 3-5 years**. The objectives of some high-priority projects in R&D areas belonging to the Scientific Workshop are listed below.

High-priority objectives of the Scientific Workshop of **Innovative Materials Technologies** in the area of materials technologies are broken down into the topics below.

Welding:

- research into high-strength steels produced by cutting-edge technology, weldable and formable structural ferrous materials and alloys, thin sheets, aluminium alloys, periodic energy input welding;
- conducting studies on modelling various welding processes, finite element analysis of technological processes, defining and determining technological parameters on the basis of modelling.

Heat and surface treatment:

- thermochemistry: situation analysis of surface technologies related to research and development, strategy elaboration, analysis of advanced technological solutions with the view on technical, economical and environmental aspects;
- conducting experiments related to thermochemical surface technologies and preparing a generation change in the human resources and technologies;
- elaborating multi-objective training projects and partially adapting a Hungarian version of the MinSE module (an international MSc course, International Master in Heat Treatment and Surface Engineering, elaborated within the framework of an earlier EU project).

Plastic deformation

- situation analysis – defining the main development directions of plastic deformation strategy with special attention to aluminium alloys and metals that are difficult to shape;
- elaboration of a detailed research program, plastic deformation processes utilizing situation factors (strength state, speed of temperature and form change), fast prototype production, single and small serial production;
- conducting comparative analysis of conventional and new innovative processes with special attention to plasticity, manufacturing accuracy and productivity;
- carrying out feasibility studies in the areas of incremental sheet forming, HydroForm and super plastic forming.

The main research objectives of the Scientific Workshop of **Precision Finishing Processing:**

- conducting development and research into the processing of gear sticks of power transmission chains of vehicles, efficient production, increasing reliability of units by developing technologies that increase the life-span of the driving chain units and by proper mounting. The objective is to support R&D&I of vehicle equipment in the region by expanding the infrastructure and by increasing the intellectual potential with special attention to precision processing of driving chain units of vehicles and developing installation techniques;
- reducing the environmental burden by applying minimal lubrication or cool-free and lubricant-free machining;
- analysing the cutting properties of aluminium alloys and cutting parameters.

The main research objectives of the Scientific Workshop of **Development of Machine and Alternative Fuels:**

- Fostering the application of numerical simulations in fluid and power engineering, developing and enhancing a better application and development of the available hardware and software parks;
- Putting into operation a motor diagnostics laboratory, making it suitable for conducting unique experiments and providing service to suppliers of the car manufacturing industry, as well as taking advantage of the TÁMOP project to provide training to the staff;

- Building a cooling engineering laboratory and a conditioning chamber for testing mechanical and energetic equipment to promote R&D;
- Conducting wind tunnel analysis to supplement basic research and meet industrial needs by utilizing the new equipment.

The main research objectives of the Scientific Workshop of i**nnovative machine design and product development:**

- Conducting analyses of driving element design (couplings, toothed gear pairs), acoustic analyses and optimisation of their dynamic behaviour and their conscious environmental applications.

The main research objectives of the Scientific Workshop of **Non-Linear Mechanical Phenomena Modelling and Finite Element Simulation**:

- increasingly realistic modelling of non-linear mechanical phenomena (engineering processing resulting in high deformation permanent set);
- further development of finite element simulation, improving methods of numerical modelling and their general application in all areas of mechanics.

The main research objectives of the Scientific Workshop of **Optimal Dimensioning of Metal Structures**:

- development of robust structure optimisation;
- applying these structures to optimal dimensioning of various welded structures and of plastic materials strengthened with fibre with the view of low costs and weight;
- fire and earthquake protection design;
- paying special attention to noise and oscillation in optimisation and performing measurements with the Brüel-Kjaer instruments of the department.

The main research objectives of the Scientific Workshop of **Developing Innovative Environmentally Friendly Technologies and Increase of Energy Efficiency** which are in line with international trends:

- to develop environmentally friendly chemical technologies;
- to conduct research into handling hazardous waste and to develop advanced environmentally-friendly and energy-efficient treatment methods;
- to establish and to develop a synergy between waste management and an increase in energy efficiency.

The main research objectives of the Scientific Workshop of **Computer-Aided Engineering:**

- to elaborate computer aided and tool designing methods and their application in different material technological processes;
- to apply AutoForm and Deform 3D program kits in the finite element modelling of plastic deformation technologies and their tools.

Impact analysis

Elaboration of technological variants based on a periodic energy input equipment background that can be directly adapted in structure production is of essential importance in welding formable thin sheets for light structure production. The planned welding processes improve the quality, reliability and loading capacity of the welded structures.

Attaining theoretical and research knowledge of new innovative forming technologies (incremental forming and HydroForm process) and their further development are important objectives in the area of plastic deformation.

Performing analyses to find whether different ferrous materials and alloys can be formed and providing a clear-cut definition of forming boundaries is of utmost importance.

Developing complex forming examinations combined with measurements with advanced optical instruments is essential. Integrating the computer-aided technological planning and the finite element modelling into a common system is also important. Another aim is to create a unified integrated system for finite element process modelling and technological and tool design, to establish conditions for optimal planning and production processes.

Compared to traditional (solid and gas) thermochemical processes the plasma procedure has several advantages, because of shorter treatment time, lower gas and energy consumption, better reproductivity, more flexible regulation, opportunities for environmentally-friendly technology and higher cost efficiency. Research into these environmentally-friendly and energy-efficient technologies and their utilisation across Hun-

gary can be performed efficiently in international collaboration. The main objective of the research is to conduct comparative analysis of the effect mechanisms of plasma processes supplemented with gas medium, plasma and active screens and to optimise their technological processes. This requires a complex analysis of surface properties and mechanical properties among others, which can be performed with the 'multifunctional, modular micro nano surface examination system' purchased within the framework of the TIOP project, providing greater opportunities for the department. The increase of the intellectual potential with the objective of achieving a multiplicator effect provides an opportunity to effectively incorporate not only the knowledge improved within R&D into all levels and forms of training, but the results of educational development attained in European collaborations during several decades. The research work performed by the project participants will be incorporated into all levels of education of the Bologna process (BSc, MSc, PhD Sályi István Doctoral School), induce SRS activities and expand programmes catering for talented students in research groups. R&D topics will result in improving the intellectual potential and increasing the number of people with scientific degrees (PhDs). The project will enable us, after preliminary negotiations, to attract back talented students who have emigrated abroad or were offered jobs in industry and involve them in teaching and research. As a result of this, the high-quality development of priority research areas can be attained. The amount of high-quality publications and received citations will considerably improve. The outcomes will be applied in industry and R&D will generate income for the university. R&D income is likely to increase by 4-5% annually. The distribution of this proportion will be uneven. The project sustainability after its maturity will be attained from national and international project funding or from R&D services provided.

Proposal

Those in charge of R&D sub-strategy elaboration shall prepare proposals related to future sustainability and funding of the Centres of Excellence.

7 SUMMARY

The objective of this strategy creation was to enhance the scientific impact and role of the University of Miskolc in international scientific life, to make the region attractive for actors of the business sector by competitive achievements of the supported Centres of Excellence, and to provide conditions for quality development of higher education in the region.

The objectives of the Centres of Excellence can be grouped around four strategic objectives: **development of the intellectual potential, development of the infrastructure, quality development of priority research areas and development of the institutional system of relations.**

In the area of developing intellectual potential the system of project instruments shall be consciously used for the following purposes:

- All scientific workshops shall involved talented students (BSc, MSc, PhD students) in research work and at least one-third of resources shall be allocated for this purpose in the Centres of Excellence;
- The proportion of academic and research staff shall be two-thirds at the faculties undertaking a determining role in the Centres of Excellence (employing young researchers obtaining their PhD degrees in the doctoral schools of the university, expatriates and researchers from the region, abroad and nearby countries) with the objective of providing a realistic opportunity for winning the title of an outstanding higher institution or the status of Research University.;
- The clearly formulated quality criteria (publication, outstanding researcher performance, caring for talented students and creating intellectual value) shall be executed in the application and employment practices of the Centres of Excellence and in the related monitoring and assessment.

In order to meet the set objectives the following activities shall be performed:

- rationalisation of the system of institutional operational processes and decision-making competencies,

- revision of the system of requirements of the academic staff,
- making the necessary amendments and corrections,
- those responsible for the strategy on human resource development shall prepare the relevant proposals.

In the area of research infrastructure development the system of project instruments shall be consciously used for the following purposes:

- objective determination of the infrastructure development directions,
- prevention of parallel developments (Instrument Coordination Group, functional laboratory integration),
- increasing the operational efficiency and income-generating capacity of the laboratories,
- so that economic players can participate in the operation of the laboratory infrastructure and in the increase of its utilisation.

In order to achieve the above objectives a new financing and operation model of the University of Miskolc shall be elaborated to considerably increase the operational efficiency of the laboratories. The person responsible for preparing the strategy on infrastructure development shall prepare the relevant proposals.

The project resources shall consciously be utilised in order to develop the institutional system of relations and presence in scientific life:

- recognition of the academic and research staff publishing above the average,
- development of the Publications of the University of Miskolc into internationally peer-read journals,
- elimination of the current compartmentalised organisational structure and establishment of an efficient knowledge-transfer organisation,
- establishment of individual interests, formulation of clearly cut and transparent rules in order that knowledge having an income-generating capacity shall remain in the sphere of interests of the University of Miskolc.

In order to achieve the above objectives the management and operational processes of the system of employment requirements, the regulation of intellectual property mana-

gement and the regulation of activities utilising free capacity related to basic activity shall be revised.

When approving the annual budget of the institution, the amount so determined shall be disbursed as a proportion of publication activities (as a part of the scientific normative). The person responsible for the scientific achievements utilisation plan shall prepare the relevant proposals.