

**INTERNATIONAL CO-OPERATION AND INDUSTRY-ACADEMIA LINK
IMPROVEMENT FOR ENGINEERING STUDENTS
AT UNIVERSITY OF MISKOLC**

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Abstract. – International co-operation has the objectives to send students to European Union and other European Universities to prepare their diploma theses abroad, getting familiar with these standards of the other European Universities, gaining experiences both in industry and University and they defend the thesis at Miskolc frequently with the presence of foreign professors. In such a way the students could work in an entirely international environment. The Faculty has direct contracts with several Universities to implement this target and mobility flows as well. This experience provides a good chance for the students and this priority should be underlined when they are applying for a job.

Academia-industry link is another important component in engineering education: one leading multinational company in the world is Robert Bosch GmbH which has a large sister company in Miskolc and also others in the region of North-East Hungary. The link is fruitful and verifying this statement there was a new Robert Bosch Department established within the Faculty by special request of the Company and it leads the improvement of the link. Bosch companies receive plenty of students for industrial practice, diploma thesis preparation and invite several students each year to be employed in various units of the company. In addition, many topics of scientific research are dedicated to Bosch requirements. The link is vital with many other multinational and national companies settled down and working in the region. There are two Research Centres attached recently to the University with the involvement of enterprises.

1. INTRODUCTION: CRADLE, PAST AND PRESENT OF UNIVERSITY OF MISKOLC

Central organisations of countries established military schools at the beginning of the 18th century in Vienna, Brussels, Paris and in other capital cities. However, it was evident that various sectors of economy required also well-trained executive officers and specialists. Mining and metallurgical industry belonged to the exchequer and they were integrated into large systems dealing also with animal husbandry, forestry, food and drink production and in addition, machines and equipment, energy transmission chains, water supply were produced by the system. Such economic sphere was termed in Latin as *montanisticum* and in German *Bergwesen*, *Bergbauwesen* or *Bergbau* covering the meaning of unified self-supplying mining and metallurgical engineering system.

The Royal Chamber in Vienna, issued a decree on 22 June 1735 on the establishment of a "Berg-Schola" (School for Mines and Metallurgy) in Selmechánya which is situated now in Slovakia. The objective of the School being one of the first engineering Colleges in the world was to train executive officers first of all for the exchequer-integrated mines and metallurgical industry and for private industry, too. The duration of education and practical

training was 2 years and five branches were listed as exploitation of a mine and laws relating to mining, measurement performer, ore preparatory, chemist and metallurgist, coinage specialist and gold-examiner.

In 1770 Academy rank was awarded by the Queen, Maria Theresa by the decree on *Systema Academiae Montanisticae* and the duration of the education was three years. In 1809 a course of philosophy was introduced involving mathematics, physics and logics and such courses proved to be the basis for the Universities of Sciences. At the beginning of the 19th century the duration of study was increased up to 3.5 and 4 years. The number of students that time was about 200 and one-fourth received stipend. The language of teaching in Selmechánya until 1868 was German and step-by-step Hungarian. Professional books and teaching materials presented the state-of-the-art of engineering education and these 6,000 books serve as a Library Museum now within the University including textbooks by Galilei, Newton, Bernoulli, Agricola, Boyle, etc.

The Royal Chamber of Vienna in 1786 invited internationally recognised scholars among others Hawkins of Britain, Ferber of Sweden, Charpentier of Germany, F. d'Elhuyar of Mexico to an international conference in order to exchange views on the new amalgamation process worked out by J. Born in Selmechánya. That was the right time for J. Born to organise the first "Societät der Bergbaukunde" (Society for Mining and Metallurgical Engineering) and it had 154 members from scientific and cultural fields like Lavoisier, J. W. Goethe, J. Watt and with sessions in 15 European and American countries.

The revolution and War of Independence in 1848-49 mobilised both academic staff and students for participation in defence of the Academy or fighting against the Austrian troops. After some months of break the teaching started again on 27 January 1850, few professors were dismissed, the famous physicist Christian Doppler (1803-53) went to Vienna.

New schools were established for the Austrian students in Leoben and for the Czech-Moravian students in Příbram. Later on these institutions received academy ranks.

In 1867 with the Austro-Hungarian Compromise the academy became the Hungarian Royal Academy of Mining and Forestry. At the turn of the 19th to the 20th century the academy was upgraded with new buildings and up-to-date laboratories.

During World War I 80% of the students went to the front line, more than 50 of them died at several battlegrounds in Europe, and many of them were seriously injured or became prisoners of war before they could return to their Alma-Mater.

After the World War I in 1919 – when Selmechánya became a city of the newly formed Czechoslovakia – the University moved to Sopron, Western Hungary. Mostly owing to the armed resistance of the students, Sopron was not given to Austria in the peace treaty of Trianon, 1919. The teaching in Sopron started on 28 April 1919.

In 1929 the Publications of the department of mining and metallurgy in foreign languages came out, which are still alive under a different title.

In 1931 the institution became the faculty of mining, metallurgy and forestry at the newly established József Nádor (Palatine Joseph) University of Technology and Economics in

Budapest with 4.5 years of study. The number of departments was 27. The departments of mining and metallurgy operated in this organisation until 1949.

World War II resulted in big losses in human lives, food, housing, clothing, schools, Universities, roads, rails but Hungarians wanted to work and live. The Peace Treaty of Trianon in 1919 granted 2/3 of Hungary's territory and 1/3 of her people to the neighbouring countries. She lost 98.3% of ore mines, 30% of hard coal mines and 100% of the rock salt mines and the known carbon-hydrogen fields. The city of Miskolc has applied for a University of Technology several times before the War, but the success came in 1949 by the Acts 22 and 25 on the Restructuring of Budapest University of Technology saying: "for the advancement of higher engineering education a Technical University for Heavy Industry has to be established in Miskolc. The university will contain faculties of mining, metallurgical and mechanical engineering." Between 1949 and 1959 the departments of the Faculty of Metallurgical Engineering and the Faculty of Mining Engineering gradually moved to Miskolc. Based on the respective courses of the former college and utilising all its buildings, today's University for Forestry and Timber Industry was created in Sopron.

The present site of the university in Miskolc was chosen in February 1950. The area was about 85 hectares. In the autumn of 1951 the students and professors took possession of the first new University buildings. In 1953 the first degree award ceremony was launched in Miskolc.

In 1959 the three faculties had 28 departments. In the early 1960es the central workshop, the main building of the university with a large lecture hall, the up-to-date refectory, the seventh student dormitories, the central library, the sport hall, etc. were built up. The university had more and more facilities for postgraduate courses, and for the organisation of domestic and international scientific events.

Currently the University has been expanding and now has three engineering faculties (Mechanical, Earth Science and Technology, Material Science and Technology) including specialisations in information technology, mechatronics, electrical engineering, mechanical engineering, mining, environmental engineering, and many others. The academic staff has 400 members and the number of full-time students exceeds 4300.

Since 1983 new Faculties were established as of Law, Economics, Social Science and Humanities, Health Care. In addition, a Music School and a Teacher Training College was attached to the University, thus the total number of academics exceeds 800 and that of full-time students' is over 14,000.

The University of Miskolc is making several huge efforts to be an efficient, successful institutional member of the European Higher Education Area (EHEA) and the European Research Area (ERA). The majority of graduates will be working in industry/enterprises, their research output help them to contribute successfully to the improvement of their economy sector. Research laboratories are the flagships of competitiveness, thus innovative graduates are the most important players in ERA. Graduates of high standard can get admission to PhD programmes and after receiving the degree some of them are recruited to be a member of academic staff [6].

Many academics are playing important roles in various domestic and international scientific bodies, editorial boards of periodicals, symposiums, conferences and seminars,

referees for RTD applications' evaluation, running several projects, acting as visiting professors, invited speakers, chairpersons and fulfilling many other outstanding duties. All in one, their international recognition improves the University reputation both in engineering education and scientific research as well [1].

2. ENVIRONMENT FOR ENGINEERING EDUCATION IN CURRENT YEARS

The advantages of the European integration are presented by few figures indicating that Western Europe gained 0.3 trillion (10^{18} = one trillion in British term and one quintillion in US term) US dollars from foreign trade sector in 1950 while this figure was 20-times higher in 2000. The Member States of the European Union (EU) increased their GDP per capita between 1973 and 2000 by 50%. In 1995 the EU had 15 Member States with 370 million population and seven trillion US dollars of GDP, thus it became an equal partner to the US. The giant European Single Market receives 75% of export goods coming from Europe in comparison to the former 30%.

Europe has some 4,000 institutions of higher education in 45 countries. 1,000 of which are genuine "universities" on the basis of the criterion of being authorised to award doctoral degrees i.e. PhD or equivalent degrees. Higher engineering education institutions play vital role because currently more than 50% of economic growth is directly or indirectly attributed to technological progress. The **knowledge-based society** where engineers are important players revolves around four pillars:

- (i) the production of knowledge through research,
- (ii) its transmission through education and training,
- (iii) its dissemination through information and communication technology (ICT),
- (iv) its exploitation in the process of technological innovation.

Nearly 7% of higher education students in the Member States come from foreign countries. Most of the flow (2.4%) is in the form of inter-Union mobility. Of the remaining 4.6%, 1.7% come from Asia and Oceania, 1% from Africa, 1% from non-EU European countries and less than 1% from the US. The United Kingdom has the highest intake of foreign students (15%), followed by its small neighbour, Belgium (11%), which has a particularly large proportion of African students. More Greeks (53,000) than citizens from any other Member State travel within the EU to study. They are followed by the French (36,000) and the Germans (35,000). There are also some favoured destinations: the Chinese prefer Finland, the Greeks have mobility flows mainly to Britain, the Turks to Germany and the Americans to Ireland. Logically enough, former colonial powers welcome students from their former colonies.

The "hard" sciences and technologies attract a large number of foreigners. In these days they represent 32 to 35% of the total in these branches in the UK, or more than twice as many as for all the other specialities combined. In France, they account for 5% of master students and 29% of doctoral students including a large proportion of North Africans.

EU programmes have proved a considerable aid to mobility over recent years. In the early 21st century, for example, roughly 100,000 students and 12,000 academics benefited from the Erasmus scheme a year. Some 40,000 people took part in the Leonardo programme, which supported academia-industry mobility projects between 1995 and 1999.

It is well worth mentioning that University of Miskolc is participating in organised mobility flows over the European average percentage, but hosts less students. Those graduates who worked out their theses based on projects at EU Universities could obtain the best jobs.

There were and still are several European Commission projects existing between institutions at European level improving quality of higher education by staff exchange, training abroad programmes for students, modernisation of premises and equipment, introduction of new teaching methods, harmonisation of course content. Such well-designed programmes involved the former Central and Eastern European institutions by TEMPUS, TEMPUS TACIS and other schemes. Important step was the involvement of institutions into the Research and Technological Development (RTD) Frameworks giving chances both to academics and students to get acquainted with up-to-date technology, to get familiar with research projects, gain experiences in innovation and technological development, strengthening the link with enterprises and pave the way for working in the new integrated Europe.

Sustainable development goes back a little more than thirty years when there was a small, informal group set up termed the Club of Rome, headed by *Sicco Mansholt*. The newly formed Club published a report, the title of which sparked immediate controversy: *An end to growth*. Over the intervening years as the global economy has developed at breakneck speed somewhat naive slogan has become a thing of the past. Yet the furore over this Mansholt Report proved to be extremely useful. In 1987, on the instructions of the United Nations, the World Commission on Environment and Development, headed by the Prime Minister of Norway, *Gro Brundtland*, developed a political concept which would quickly be adopted as an absolute priority: sustainable development. Brundtland's genius lies in the simplicity and realism of the stated goal: to meet the needs of present generations without compromising the capacity of future generations to satisfy their own. Sustainable development is a global need, thus each engineer also in Europe must work on its successful implementation.

The concept soon met worldwide approval and, in 1992, formed the basis of one of the most important international summits in history. More than 120 heads of state and governments and thousands of delegates from all over the world met in Rio de Janeiro to give shape to sustainable development, in particular by adopting Agenda 21. Rio also marked the start of negotiations which led most significantly, to the Convention of Climate Change, otherwise known as the Kyoto Protocol envisaging the voluntary reduction of greenhouse gas emissions (mainly, but not exclusively, carbon dioxide or CO₂) and other similar summits are also in the focus.

3. INTERNATIONAL CO-OPERATION IMPROVEMENT

3.1. Background

International co-operation can be structured in five significant components like (i) bilateral agreements on staff and student mobility flows on education and RTD schemes with the former Central and Eastern European Universities, overseas countries, (ii) participation in various EU education and RTD programmes, (iii) hosting and participating in annual, biannual international conferences, seminars, workshops, (iv) professional publications in

domestic and international periodicals, conference proceedings, book writing, and (v) application and implementation of projects announced by EU and Hungarian authorities.

The mission of the university is formed by a combination of major insights, commitments, values and efforts: the establishment and maintenance of an integrated HEE institution that meets the standards of today by producing well-trained and highly qualified graduates, and by active participation in the scientific and social life of the nation and the world. The university is committed to the continuous adjustment in the contents and structure of its academic programmes to respond the global and European developments in HEE. The university is committed to establish priorities in professional and scientific training to promote Hungarian and global cultural values, to be tolerant towards national differences, to explore and utilise the specific opportunities arising from its geographical position.

3.2. Early bilateral schemes

The widespread international relations of the university have both narrow and broad profiles during the past decade. Previous relationships (mainly with countries in Eastern Europe) have been transformed or, in some cases cancelled. On the other hand, broadening has taken place through the growing number of partner institutions in Western Europe in the form of joint international projects and bilateral agreements. These agreements, amounting to more than 60 institutions and based on co-operation contracts, play an utmost important role in the international relations of the university. They also have an effect on the development strategy of the university, as the international trends should be taken into consideration. The agreements lay down the main trends of research, which influence the standard and structure of education, too. The major forms of international relations are as follows:

- exchange of information, professional literature, teaching materials, technical books
- joint research, preparation and submission of projects
- participation in international conferences, events, performing lectures and presentations
- short visits and scholarship-funded study trips
- student exchange, summer practice, study trips
- receiving visitors, visiting professors
- participation in the work of international organisations.

3.3. Participation in European Union/Commission Projects

As soon as opportunities became available, the University of Miskolc did not hesitate to join the major European educational and research projects (TEMPUS, CEEPUS, SOCRATES, LEONARDO, NATO Civilian Sector, EU Framework Programmes, etc.). A wide-ranging partner network has burst into life, which will serve as a firm basis to realise our future objectives.

Special attention and priority have been attributed to approach the standards set up by the EU. A Work Committee has been formed from the representatives of the universities – the University of Miskolc being among them – to work out proposals for the realisation of the tasks needed by the Bologna Declaration.

The university is convinced that its strengths (long historical traditions in education, highly qualified and experienced teaching staff, vivid international relations, successful participation in international projects, an ever-transforming training structure and

educational profile meeting the demands of a rapidly changing world, flexible university management, quality assurance) will soon overcome some weaknesses that still exist (not enough courses offered in foreign languages, shortcomings in infrastructure and information technology (IT), rather late introduction of ECTS, low number of students speaking foreign languages at high level), but will hopefully be eliminated in the coming years.

The university is strongly committed to preserve the strengths described above and to reduce weaknesses to a great extent. The realisation of the aims will make the university an equal member in the community of European Union universities.

These aims and priorities are as follows:

- improve the good command of foreign language of our students and teaching staff
- create the environment for launching engineering programmes in foreign languages (both for Hungarian and foreign students)
- adapt fully the European Credit Transfer System (ECTS)
- improve the international character of engineering curricula by integrating state-of-the-art Information and Communication Technologies (ICT)
- offer a greater variety of programmes (two-tier programmes, in particular; distance and adult education; post-graduate courses)
- develop our competitiveness and appeal in the field of international education and research
- encourage our students to take up the course on European Studies and to offer this course to other target groups outside the university
- apply quality assurance in education to a greater extent
- keep, even improve the standard of degrees.

These general principles for the future absolutely coincide with priorities in the SOCRATES programme. The University of Miskolc has maintained contacts with a great number of European universities in the framework of ERASMUS in the past few years. Priority has been given to staff exchanges which cover other activities in addition to teaching and enhance the university's joining CD projects. The achievements of the development of emerging scientific areas must be present in education in an internationally unified form. It is desirable to raise the number of graduates in order to enable them to meet the challenges of the European labour market after graduation. We will involve more students not only in mobility activities, but will also encourage them to participate in other international projects and practical placements abroad. Additional efforts will be made to attract foreign students to the university, to offer them suitable courses in foreign languages and to guarantee the mutual recognition of studies. In the previous years, the three engineering faculties worked out 5-year degree programmes in English, which were originally planned for fee-paying foreign students. However, the revision of the curricula and structure of these courses is necessary. The new course curricula will help to reduce the dropout. We will raise the awareness of our teaching staff on how important the participation in mobility activities, joint curriculum development, then research and joint international projects is. We will find the necessary incentives to involve academic staff in individual study for refreshing and developing their language proficiency. The university has highly-qualified administrative staff in its International Relations Office, who gives considerable orientation and support to all international activities.

The University of Miskolc has been participating in two other actions (LINGUA, MINERVA) of the SOCRATES programme and we think that this is the right way for us

to march in the future. We will find broader opportunities of co-operation in these fields, as conditions to promote these two actions are created: several English and German language departments, a Language Centre, highly-qualified language teachers and a degree programme for English and German language teacher training are available. Similarly, distance education (DE) will face a bright future since the North-Hungarian Regional Distance Education Centre has been established at the university.

The university is strongly committed to contribute to the Europe of Knowledge and its cultural and scientific traditions. The Bologna Declaration is a guiding principle in defining the main objectives to be obtained. The Hungarian government is to raise the number of students in higher education up to 50% of the 18-23 age group by 2010. It calls for re-organise the structure and transforming it into a two-tier system by strengthening both the theoretical courses and the practice-oriented technical background. The nationwide introduction of the ECTS brings the transparency, the compatibility and the mutual recognition of studies are important targets as well.

There are two large-scale European commission projects well worth mentioning such as E4 and TREE. The acronym E4 comes from the initials of Enhancing Engineering Education in Europe and was effective between 2000 and 2004 with over 110 higher engineering education institutions. It targeted the most important challenges and respective responses by HEE like curriculum development, management, structure, new teaching methods and materials with the involvement of information and communication technology (ITC). The last year was dedicated to the dissemination of the project. The contractor and co-ordinator was University of Florence. UM and the Faculty nominated delegates and publicised its achievements mainly by the Hungarian Tempus Foundation.

Training and Research in Engineering in Europe (TREE) Thematic Network Project under Socrates-Erasmus Scheme worked between 1 October 2004 and 30 September 2007 and now the dissemination year is running until 31 October 2008 with the participation of over 120 HEE institutions TREE project developed the activities along five main lines as tuning, education and research, attractiveness of engineering education, sustainability, accreditation. UM and the Faculty were and are still active within the project and contributed to publicise its achievements by various means. The contractor and co-ordinator is still the University of Florence.

3.4. Staff and Student Mobility Flows

The university ensures high quality in student and staff mobility and in ERASMUS Co-operation in various ways:

We intend to put more emphasis on and to strengthen the objective criteria for the selection in student and staff mobility flows. The range of criteria should be broadened by taking more parameters into account. Selection procedures will be monitored regularly, with special regard to language skills. The Erasmus study programme of students will be discussed, approved and controlled at faculty level, too. This also applies to outgoing staff: the teaching materials they are going to present at partner universities will go through a faculty-level approving procedure, thus guaranteeing the high standard of teaching. We will encourage our staff to find specific topics being complementary, to the core curricula, in different subject areas at the partner universities. We would like to strengthen the unique character of what we can offer to foreign students. Examples already exist: the course in

Intercultural Communication worked out by the staff of the Department of Applied Linguistics is very popular and is a recurrent topic at our partner universities each year; or the course in Hungarian Grammar and Cultural Studies taught by our staff at a Finnish university in Finnish and Hungarian languages. To raise the number of staff in mobility is inevitable, however, financial constraints have prevented us from giving more opportunities in mobility activities to our staff. Yet, the university – as an enterprising university – will do its best to find additional resources.

We are aware that we must change the unfavourable balance of incoming/outgoing statistic figures. It is important for us not only to send people, but also to receive more students and staff. To exchange experiences and to have intellectual contribution to our education from our partners are important achievements. The nation-wide introduction of ECTS gave a step forward in terms of competitiveness and the mutual recognition of studies. It will be easier for our students to compile a study programme and to take up more course units. The management of faculties will take the necessary measures to make the departments efficient and launch more courses in foreign languages, primarily in English, where Hungarian and foreign students can study together, to make a better use of the language potential of the teaching staff. It will be the task of the departments to promote incoming staff mobility and to encourage the staff of the partner departments, in most cases on the basis of long-standing co-operation, to bring their knowledge and experience to us.

Though the university has not yet been involved in other ERASMUS actions, some positive changes which can continue with participating in curriculum development and education management projects are already visible. We will definitely fortify our position in these new areas, relying on the huge experience of our teaching staff in the preparation of teaching materials, which is based on several previous TEMPUS projects [2]. Recently, some of the partner universities have expressed their intention to work with us, which has been received with positive reactions by the respective departments.

Improving the quality of mobility activities will be supported by the Project Network (both an office and its services) and the Quality Assurance Office. The Project Network is an easily accessible information system – with its own web-page - on the most significant educational and research projects the University of Miskolc is taking part in. The ERASMUS section is available in English version, too. The project managers will regularly monitor the implementation of the projects and will be supervised by the Vice-Rector of International Relations, who will submit reports and recommendations to the University Senate for approval and assessment in view of the long-term development strategy.

The principle of equal chances, equal treatment and no discrimination as for sex, race, religion and social status is the university's firm standpoint. Statistics show that the university has a growing number of female students and this circumstance is reflected in the favourite ratio of outgoing male/female ERASMUS students, too. The university has a special advisory service for physically handicapped students and will give the necessary help to the physically or socially disadvantaged, both in terms of human treatment and financial support. The latter is underlined by the fact that the city and its region is an economically poor area, with high unemployment rate and a great number of students live here without having intellectual background.

In 2006, the university management worked out both the short and long term institutional development plan. The objectives and mission statement put down in relation to international activities. In order to provide high-level quality in education and research, the university launched a reliable quality assurance system. With experience gained and professional relationships established in the past decades, it is guaranteed that the university can be a successful actor in the ILLP as well. Among the different actions, priority is given to the mobility of students and teaching staff to be performed in growing numbers and at the possible highest standard. Each faculty puts special emphasis on the study abroad programme and placement of students. To raise the competitiveness of students, to improve their professional and language skills and their recognition in the global labour market are of utmost importance.

Our university has been successfully participating in the Leonardo programme for many years. We are going to expand the circle of receiving companies by encouraging our faculties to mobilise their existing industrial/business partners. Besides Erasmus, our university was a partner in several EU educational and research projects even before. It is our definite aim to participate in Intensive Programmes and Thematic Networks within Erasmus, and in the Grundtvig, Jean Monnet and Transversal programmes outside Erasmus.

The transparency of Erasmus actions will be provided by broad publicity and a follow-up system. For smooth operation, we have established a new structure: the Institutional Erasmus Network, which formulates the basic strategic principles in cooperation with the university and faculty management. Calls for applications and the precise conditions of the procedure will be published in a broad circle, via different information channels. For the fair selection of mobility applications, a point-based assessment system will be used; final decisions will be made by faculty and institutional committees. Assessment criteria and final selection results will be accessible on the internet and notice boards. Foreigners will be welcome to this University with warm hospitality. No signs of xenophobia or racism have ever occurred.

The professional co-ordination of placements takes place at faculty level which ensures direct co-operation among the actors (host and sending organisations, tutors, mentors, beneficiaries) of the given study field throughout the different phases of the placement, such as the selection of candidates, the preparation of a work programme or the monitoring and evaluation of the personal and professional development of the beneficiary. The work programme is prepared (via personal discussions and ICT) mutually by the tutors of the host and sending organisations and by the beneficiary. Beneficiaries are assigned tasks and responsibilities, which match their knowledge, skills, competencies and training objectives and are provided with appropriate support during their placement. The sending and host organisations carry out tutoring and mentoring activities mutually via the established communication channels. Both the host organisation and the beneficiary shall submit a report in a previously specified format evaluating the achievements of the placement. Practical placements form an integral part of most training programmes (such as health care studies, law, engineering studies, economics), which ensures the direct recognition of the foreign placements. The EUROPASS mobility card is issued to all beneficiaries.

The credit accumulation system and the two-tier education in accordance with the Bologna Declaration are already in use at the university. Emphasized priority will be given to the recognition of studies and placements abroad on the basis of credits. The ECTS

coordinators at the faculties will only approve study programmes if recognition seems realistic. Outgoing students and staff can have access to necessary information and advice from the web pages of the receiving institutions, from fellow-students and colleagues who have already visited that institution, and from the staff of departments and the International Relation Office. Teaching activity abroad will be recognised as an important part of the academic career at each faculty. In several cases, complementary funding will also be granted. The high-level reception of incoming students will be based on the harmonised work of several units. The list of courses and credits offered for foreign students will be accessible on the web pages of the faculties. The study programme of incoming students will be organised by the faculty ECTS coordinators. Not only study matters, but issues of everyday life in Hungary will also be available on the web page of the International Office. Orientation meetings will be organised in each semester when incoming students obtain detailed information about administrative and study matters. The team in charge of exchange students of the Students Self-Government will monitor and tutor incoming students during their stay, and will organise various cultural, sports and entertaining events to help them get adapted to the life of the university and the country. High-quality accommodation will be provided in the renovated dormitories. Hungarian language courses for beginners in both semesters will be held by our language teachers. The professional reception of incoming teaching staff and the integration of their lectures into the curricula are managed by the host departments.

3.5. Bilateral co-operation of today

It is well worth mentioning that the Faculty puts great emphasis on bilateral co-operation with German Universities, first of all with Otto von Guericke Universität Magdeburg, then with Dortmund, Essen, Duisburg, Freiberg, München, Erlangen. Joint projects have been established particularly targeting both staff and student exchanges mainly by the financial aid of the German Foundation DAAD. This foundation have managed to establish joint research projects between the respective German Universities and UM. There are around 30% to 40% of academics participating in such joint research projects and also in the mobility schemes on behalf of UM. Technische Universität Berlin was the first West-Berlin partner of UM and this co-operation goes back to the early 1980es. Several TEMPUS projects (microelectronics, mechatronics, PhD programmes in engineering and others) enjoyed the active and efficient participation of TU Berlin staff in the Consortium activities and in the publication of the International Workshops Proceedings.

The Faculty has also vital international co-operation schemes with Universities of Leoben, Klagenfurt, Vienna, Zürich, Bath, Edinburgh, Dublin, Delft, Tampere, Zaragoza, Barcelona, Lisbon, Athens, Ankara and some others.

A little more than 10 years ago a successful co-operation started with University of Nagaoka in Japan. Until now an equal number i.e. 15 students enjoyed the mobility from both parties to the other Universities for one full semester. Universities of Muroan, Osaka and Okayama are also new members of international co-operation targeting mainly both of the mobility of staff and students.

Since the early 1960es there were co-operation schemes established with the former Eastern European Universities like Mariupol, Kharkov, Kiev, Odessa in Ukraine, Krakow and Gdansk in Poland, then Cluj-Napoca, Nagybánya in Romania, Ljubljana in Slovenia. Such international co-operation programmes are still working and due to the annual

microCAD Conference organised by UM each year early Springtime in Miskolc several academics from the above-mentioned Universities participate in such Conference which is dedicated to computer application in all engineering and other disciplines.

At last but not at least it should be noted that the highlight of international co-operation was the SEFI-IGIP Joint Annual Conference hosted by the University of Miskolc between 1 and 4 July 2007 and the Faculty staff played vital role in its organisation and smooth running.

4. ACADEMIA-INDUSTRY LINK IMPROVEMENT

4.1. Background

Academia-industry link is improved in four main ways like (i) research projects with domestic industry, (ii) establishment of University-attached research centre on mechatronics and material science, (iii) introduction of a Regional University Knowledge Centre mainly in the fields of mechatronics and logistics, (iv) joint research projects with EU universities.

Engineers, although they represent less than 1% of total employees, contribute by 20% to Gross Domestic Product (GDP) by innovation in highly developed countries. This figure envisages a new structure and content of education of students and in this way the graduates should be prepared for research and technological development (RTD). This target must be achieved during engineering education while research is playing an important role in the curriculum on the one hand. In addition, the students can perform research for industry with the assistance of talented engineers. Participation in such projects the students must be active to search for new ideas i.e. arrive at innovation and to carry out them.

There was a new 'Robert Bosch' Department of Mechatronics initiated by the German Bosch GmbH Industry with financial aid at the University of Miskolc and its operation started on 1 July 2005 involving four Bosch sister companies working in Hungary. In addition to engineering education in the fields of mechatronics for undergraduate, graduate and PhD programmes with the utilisation of new laboratories like hydraulics, pneumatics, sensor application and development, mechatronics serve both education and research. Bosch industry enjoys priority in the selection of the best graduates.

Close co-operation has been established with respective research laboratories while they are attached to the University and working in the region.

The participation in research projects in industry coincides with the national industry expectations (Table 1).

Rank order No.	Intellectual power and quality	Rank order by percentage of firms
1.	Carry out respective engineering works adequately	98.1
2.	Work in precise, accurate, recognised way	97.5
3.	Keep the deadlines at any time without delay	93.1
4.	Co-operate with colleagues in an excellent way with efficient team works or projects	93.0
5.	Being capable in engineering problem-solving	90.6
6.	Capability in carrying out specially works or projects alone	86.2
7.	Good communications skill and efficient personal contacts at workplace	82.3
8.	Creativity in engineering	73.6
9.	Engineering knowledge of high standard	72.3
10.	Capability in career success, self-management	58.0
11.	State-of-the-art knowledge in economics and marketing	38.9
12.	Establishment of professional link independently	18.4

TABLE 1: Intellectual Power and Quality needed for Carrying out Engineer Positions in Hungary – Source: Career centre, Budapest, 2004-2007

There have been several new scientific disciplines emerging in the latest decades, the University of Miskolc based on its co-operation with various industry, gave priority to mechatronics, material science, their integration with logistics and environment protection. Project achievements serve the readers to understand the way on how UM integrates education and research within the curriculum and within industry-academia link.

4.2. Co-operative Research Centre on Mechatronics and Material Science

The Research Centre (after its Hungarian initials its acronym is MeAKKK or in a shorter form MeAK3) was established on 16 July 2001 at the UM which serves as a scientific unit for medium and large size enterprises showing interest in fundamental and applied research in the areas of mechatronics and material science with the provision of financial aid. More than 30 enterprises contributed to the success by Hungarian Forints (HUF) 250 million and this input was increased by the Ministry of Education with the same amount of money i.e. with another HUF 250 million. For easier exchange, Euro 1 equals roughly HUF 250. The enterprises within the framework of the Centre are participating in specific applied research serving as solid basis for their RTD. Between 2005 and 2007 MeAK3 has been running by the aid of HUF 360 million of the Government and by 60 enterprises exceeding their aid by HUF 500 million. The increase in the input was due to the recognised achievements in the first 3-year period [3].

Mechatronics brings together traditional studies in mechanical engineering, then electronics, actuators, microprocessor and computer hardware plus computing science in their application to complex processes. The cradle of mechatronics was aircraft industry, then automobile industry followed and by now many industries are mechatronics-based. The complexity of systems is increasing and it is essential that our future engineers should be able to cross discipline boundaries. The Faculty of Mechanical Engineering is in charge of mechatronics education recognising its importance since the end of the 1980-es. Within the European Commission Tempus Scheme between 1994 and 1997 a Joint European Project No. 07374 on Mechatronics Courses was approved with the participation of Middlesex University of London as co-ordinator and contractor, Universities of Zaragoza, Naples, Cassino, TU Berlin, and UM Departments of Electrical and Electronic

Engineering, Machine Tools, Mechanics and Logistics. At last but not at least Ganz Ansaldo Electric Ltd Hungary and the Hungarian Electrotechnical Association provided industry background.

The Faculty is running mechatronics programme in 5-year-duration under the co-ordination of Machine Tools Department since 2000 which proves to be a success story. In 2004 BSc programmes started in this discipline.

Research in the field of material science deals with steel, copper, aluminium, wolfram, other metals and their alloys and in addition to composites, glasses, polymer, ceramic materials, etc. this research is co-ordinated by the Faculty of Material Engineering and Metallurgy.

The general objectives of industry-academia link within MeAK3 are as follows:

- (i) Scientific research of joint interest to be implemented within the co-operation scheme.
- (ii) Unify management of research in the fields of mechatronics and material science with the co-operation between the two large different teams and Departments as well.
- (iii) Ensure large-scale financial aid and academic support to students of MSc or MEng and PhD programmes such as stipends, visits to enterprises, the provision of tutors for diploma-work, recommendations for titles of MSc and PhD theses, preparation of joint project applications, support both from academic and financial aspects of scientific papers/projects of students.
- (iv) Build up knowledge having business aspect and marketing convertibility into the curriculum, entrepreneurship and the applied RTD.
- (v) Participation in the modernisation of higher engineering education as updating of curricula, establishment of new specialisation, etc.
- (vi) Contribute to the availability of new generation of scientifically trained engineers and other personnel of the Consortium by the enlargement of University facilities and knowledge-based teaching and research in order to apply and utilise up-to-date knowledge in practice by partners and associated members in more efficient way.

The main outputs of the projects regarding academia-industry link were as follows:

1. All projects involved the best graduates and PhD students. Some diploma works and PhD theses were prepared on the project achievements carried out by the student invited by his/her professor.
2. The projects' achievements were published at large-scale national conferences where all participating academics, industry personnel and students contributed to the discussion. The outputs were put both in graduate curriculum and continuing education programmes.
3. Valuable contributions were also presented and papers were published at International Conferences, their Proceedings and in periodicals.

4.3. Regional University Knowledge Centre

The Hungarian National Research and Technology Office announced recently applications for 'Regional University Knowledge-Centre' (after its Hungarian initials its acronym is RET). The UM application was successful and the Centre started its activity at the beginning of 2005 for four years in the first period [4]. Its President is Gy. Patkó, the Rector of UM.

The main **objective** of the Centre is to contribute to the development of new products and technologies and in addition, to the economic improvement of the region in the fields of mechatronics and logistics. This objective can be implemented by the existing knowledge-based UM and other higher education institutions and research laboratories working in the region in co-operation with nearby dominant enterprises.

Research and technological development (RTD) of the new Centre was focused into three main strategic fields:

- (i) development of intelligent components, units and products, increase of life-expectancy, thus all belong to the **world of production area**,
- (ii) mixture of materials with relevant production technologies and mechatronics application in engineering fields are connected to the **group of materials and their technologies**,
- (iii) control close to production processes, intelligent controls and logistics systems are linked to the **intelligent systems programme**.

Within the mechatronics scheme it is well worth mentioning the co-operation with Robert Bosch industry in the region and Electrolux Lehel Ltd. In the field of materials and technology there are also important partners in the co-operation programme like Prec-Cast Ltd in metallurgy and Tisza Chemical Industry. In the logistics area Borsod Volan Bus Co. for passenger services is an important member of the Centre.

The **activity of the Centre** in the first few years contributed to:

- the development of innovative products, processes and systems,
- the establishment and management of knowledge-based network,
- the commencement of the transfer of knowledge and technology,
- the reinforcement of scientific activities in the region,
- the increase of engineering education standard.

There have been over 20 important **projects** carried out and finalised in the first years successfully [4].

4.4. Joint Project with Duisburg University

The European Lisbon-Strategy has brought new challenges in Europe. Hungary and Germany agreed therefore to intensify scientific and technological collaboration by integrating German and Hungarian research laboratories and companies at Hungarian knowledge centres. Moreover it was decided to install joint research bases as a new co-operation instrument. One of these new co-operation instruments is the research base for Mechatronics in Miskolc.

The aim of the activities of the common research-base Mechatronics is to involve in a network the existing as well as future domain-specific development-tools for the development process of new mechatronic products. The form of the network will be an interdisciplinary and mechatronic development environment [5].

The Research-Base is primarily carried out by the Universities of Duisburg-Essen in Germany and of Miskolc in Hungary. The aim is to approve the approach on real examples of mechatronic component development. This target is accomplished in co-operation with the industry partners working in the region of Miskolc.

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