

EDUCATIONAL PROGRAMS AND PARTNERSHIPS IN MINERAL ENGINEERING

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Abstract

Experience over the past eight years has proven that partnership and cooperation in mineral engineering education is essential to maintain programs in this field. At this moment the joint European Mineral Masters Engineering Course (EMMEC) has three programs in the areas of mining, minerals engineering and geotechnical/environmental engineering, offered by combinations of nine universities in seven European countries.

About 25 companies are associated with the universities in the Federation of European Mineral Programs (FEMP) which coordinates these activities. The EMMEC has applied for recognition under the newly launched EU "Erasmus Mundus" program in which the EU makes 280 million Euro available for bursaries for non-European students and scholars.

Introduction

Despite decline in direct mining activities it can be stated that the mining supply, the mining exploitation and mining machinery industries play a significant roll for the European Union and its members. In addition the E.U. is a substantial consumer and processor of imported minerals. Therefore minerals engineering is important in the E.U.. It is therefore vital to maintain the very high level of knowledge and skill base in mining engineering and mineral technology which currently exists in the E.U., through a good and well balanced education program.

Mineral engineering education

As a result of the expansion of mining activities in Europe from the mid 19th century, most countries developed good quality courses for mining and mineral engineering at one or more of their universities. Most of these universities were mainly focussed at the local

industry. The globalisation of the minerals industry during the last decades required an increased efficiency and quality of higher education in the mineral programmes in the form of international Masters Courses. It also became vital to offer courses which emphasise the environment and seek to produce engineers who are able to minimise the impact of mining. The, since 1996, developed mineral programmes respond to these requirements.

Initiatives for co-operation

At the end of the eighties it became clear at many of the European Universities that, in order to offer a high quality course, it was necessary to look for innovative ways. In order to optimise and enhance the quality of education at Delft University of Technology in the Netherlands it was decided in 1990 to send the mining students during their final year to Imperial College's Royal School of Mines in London. This was the first initiative of this kind in Europe and led in 1996 to the establishment of a joint curriculum during the final year, organised by RWTH Aachen, TU Delft, Helsinki University of Technology and Imperial College. These universities were primarily chosen because of existing links, similarity in structure, culture and the wish to internationalise. The general thought was that each partner would concentrate on subjects in which it was already strong. Thus a joint, high quality, curriculum could be realised. The concurrent effect was that each university would not have to maintain the entire curriculum, which in turn would yield cost reductions. The course was named European Mining Course (EMC).

The idea is based on the belief that the universities offer a similar standard of knowledge and cover the same basic courses of study. Each of the participating universities has areas of expertise (complementary to each other) in which it is quite outstanding, and therefore can be considered to be a centre of excellence.

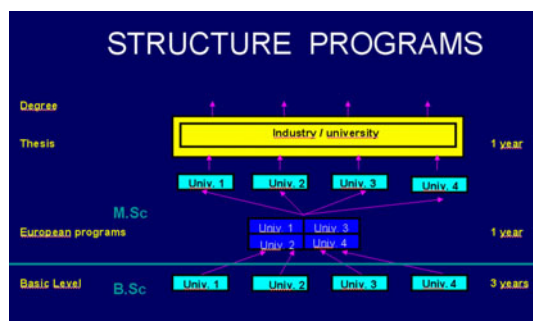


Figure 1. Structure of programmes

Students spend the bulk, of their university studies at their home university in their country of origin, where they obtain the basic engineering skills and a fundamental understanding of mining science and engineering leading to the first degree. During the first year of the graduate program, before commencing with the M.Sc. thesis work, the students of all 4 universities, as a group, spend 2-3 months at each of the universities to study the various specialisations.

During the final part of the course the students choose to develop special expertise in one or other aspect of Minerals Engineering. They carry out the (masters) thesis work under guidance of one or more of the universities, (not necessarily in their home country), which are most specialised in that particular field. Also at this stage industry is involved with student theses. Upon completion of the course the home university and the university(ies) at which the student completes the thesis project award the M.Sc. degrees.

Additional programmes

The success of the EMC led in 1998 to the start of a second program, the **European Mineral Engineering Course (EMEC)**. TU Delft, RWTH Aachen, Imperial College and Helsinki U of T were the organising partners. The emphasis of the courses is on Mineral Processing, Metallurgy and Recycling.

In 2003 a third programme started; the **European Geotechnical and Environmental Course (EGEC)**, organised by the Technical University of Berlin, TU Bergakademie Freiberg, Kosice University of Technology, Miskolc University of Technology and Wroclaw University of Technology. In this programme the emphasis is on geotechnical and environmental subjects. The organisation of these programmes is the same in all three cases.

Overseas Students

Universities that have an exchange agreement with one of the organizing universities are considered to be associates. There is also exchange taking place between students of the organizing universities and the associated universities, e.g. for thesis projects, third year courses, etc. All these universities are represented in the Society of Mining Professors (<http://www.mineprofs.org/>), which meets once per year.

Federation of European Mineral Programmes

In 1999 the positive results of the two programs, created the need to formalise the relations between the participating universities by establishing an association with a legal status. The Federation of European Mineral Programs (FEMP) was established on 16 December 1999 in Delft. The main goals being to establish stronger ties between the partners and opening up possibilities for other (European) universities and also to get a formal involvement in the programs through participating students, exchange of staff and other actions.

This led ultimately to a full scale integrated European network of mineral programmes offered by a number of universities and with assistance of the industry. It has become a first in the world on that scale.

FEMP's other aim is to be the formal contact between industry and the European universities. The Board of directors of the Federation consists of representatives of the Academia and the Industry. Representatives of each of the participating companies are members of the Industrial Advisory Board.

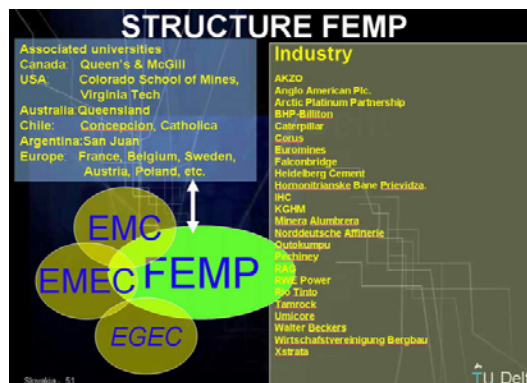


Figure 2. Structure of FEMP

The importance of opportunities for students to carry out internships is also becoming evident to the Industry.

This year Riotinto and Anglo American offered some 25 internships worldwide. The internships are important for the students, but also for the companies, who see it as an ideal opportunity to spot potential candidates for positions. Students went to a/o: USA, Chile, South Africa, Brazil, Ireland, Botswana, Poland, etc.

In 2004 the four major mining companies with an office in London (Rio Tinto, Anglo American, BHP-Billiton and Xstrata) joined forces in the Minerals Industry Education Trust (MIET). These companies are very concerned about the future and are actively supporting the organisation of FEMP with funds and with assistance in carrying out surveys to get a good picture of the future supply and demand for mineral engineers.

Financial Arrangements

The cost of giving the courses is in fact part of the universities normal cost for education. The co-operation now reduces the cost to an economical level, as the partner universities do only part of the education.

The extra costs for students (in addition to what they normally need during the year) amount on average to 3,000 Euro per student, of which up to 1,000 Euro is covered by travel bursaries from the European Commission (Erasmus / Socrates programme). The other 2,000 Euro is mainly the cost of accommodation. These costs are for the largest part covered through contributions of the industry via the *Federation of European Mineral Programs (FEMP)*.

The additional costs to the universities are mainly travel and accommodation expenses for company visits and are estimated at 5,000 Euro per university per year.



Figure 3. Workshop Heidelberg Cement

Alumni Contacts

Since the start of the programmes the number of alumni has grown to over 200. Maintaining contacts between those and also between the alumni and the Industry is considered as one of the strong features of EMMEC.

Each year a reunion is organised, coinciding with the meeting of the Board of FEMP (same board as from EMMEC). This reunion and meeting is held at a central location in Europe. Apart from the constitutional meetings the programme includes a workshop organised by one of the Industrial members of FEMP. The programme also includes social events such as a reunion dinner and social activities during the second day.



Figure 4. Survival program reunion

All current year students are participating, as well as alumni and representatives of Industry and Academia. Last year over 100 persons participated.

e-Techniques

Since two years a “virtual learning environment” called BlackBoard is in use for the EMC and EMEC. The system contains all 47 subjects as well as general programme information for EMC, EMEC, FEMP and for the alumni. The BlackBoard site can be reached at: <http://blackboard.tudelft.nl/>. It is possible to download documents, like the Course Summary. BlackBoard improves the efficiency of the organisation, because all 9 universities can access the system and put course material, information, grades, etc. on it.

Since the start of the two Mineral Engineering Programmes there has been a great interest by Industry, other students and other universities either to participate as a student, or to offer courses for the program. Unfortunately the logistical limits of the programmes did

not make this possible. One cannot accommodate more than 20-25 students per programme and one cannot expand the number of universities to be visited within a time period of eight months.

One of the future developments is to use the organization, infrastructure and e-learning techniques (BlackBoard) already in place with the EMC and EMEC programmes as a base for developing on line courses offered by the consortium of EMMEC universities.

Erasmus Mundus Masters Mineral Engineering Course (EMMEC)

In 2004 the European Commission has started the new "*Erasmus Mundus*" program. Erasmus Mundus will stimulate the offering of joint programs by European universities and offer students and teachers from outside the EU a greater opportunity for mobility. European postgraduate courses will be selected for a five-year period. They will receive funding from the Community and an "EU" seal. Around 250 Erasmus Mundus Master Courses" will be established.

The nine leading European Universities have proposed to offer their existing joint Minerals Engineering M.Sc. as an Erasmus Mundus Master Course. It will be a fully integrated two year course with three modular programmes (EMC, EMEC and EGEC) offered by nine partner universities:

- RWTH Aachen, Germany
- TU Berlin, Germany
- Delft University of Technology, The Netherlands
- University of Exeter, Camborne School of Mines, United Kingdom
- TU Bergakademie Freiberg, Germany
- Helsinki University of Technology, Finland
- Kosice University of Technology, Slovakia
- Miskolc University of Technology
- Wroclaw University of Technology

The course is a multiple location course and structured around three main programs: the European Mining Course (EMC), the European Mineral Engineering Course (EMEC) and the European Geotechnical and Environmental Course (EGEC). The course consists of two parts:

- 60 ECTS points in taught coursework offered as modules at 4-5 of the different organising universities
- 60 ECTS points at 2 of the partner universities including the thesis project

The student may register for one of the three programmes or in special cases may choose to combine part of two programs. The student gets M.Sc. awarded by those universities at which he/she spends at least 30% of the total time.

These double degrees will be two local M.Sc. degrees until joint degrees have been approved by the national legislation. The thesis subjects are linked with the research projects of the partners, which are aimed at the local research specialisation. The subjects not only reflect the state of the art technical aspects of the research of the partners, but also have a strong link to the society's needs for a sustainable use of the Earth's resources with minimum impact on the environment.

Upon completion of the EMMEC course the student has acquired a good general understanding of the various processes involved in the exploration, exploitation, extraction and recycling of Mineral Resources at an advanced academic level. More specifically these processes include:

- Geo-sciences (geology, geophysics, geotechnics)
- Mine planning technology (modelling, computer applications)
- Mining technology
- Rock engineering (stability analysis)
- Mineral processing technology (flotation, physical and chemical separation)
- Extractive Metallurgy
- Recycling technology
- Cash flow and financial analysis
- Market situation
- Modelling and simulation
- Environmental issues
- Sustainability

The student will also have acquired further in depth knowledge of several aspects in a field which attracts most of his interest.

- Capability of understanding a wide variety of problems and being able to formulate these at an abstract level.
- To comprehend on an abstract level, the relation between diverse problems and to contribute creatively to their solution focused on practical applications.
- Ability to integrate knowledge from separate disciplines.
- Capability of working in an interdisciplinary team of experts performing the aforementioned activities and communicating easily in both written and oral English.

- Capability of working and learning independently and of taking initiatives where necessary. Identifying areas where expertise is lacking and remedying the situation.
- Capability of making presentations of one's own activities to diverse audiences. Ability to adapt to the background and interest of the audience.
- Knowledge of technology-related developments in society, such as sustainability issues. Capability of developing and defending opinions in this area.
- General creativity and a problem solving attitude.
- Ability to manage project and team oriented problems.
- Ability to deal with different cultural environments.

In principle each of the three programmes has room for 25 students. Between 1999 and now an average of 30% of non EU students was obtained. Therefore a total of 20 non EU students for the three programmes (total 60 students) should not give any problems.

The distribution of students is part of the selection procedure. Students apply for one of the three programmes and also give a second choice if applicable. The combination of hosting universities during the second year will be determined during the course of the first year, based on the subjects in which the respective institutions specialize and the students' interests. Provided that the students' background match their interests and within the limits of availability students will be distributed over the consortium partners according to their wishes.

Selected students will receive a scholarship of 21,000 Euro per year to join the Erasmus Mundus Masters course.

The programme also supplies scholarships for scholars who will stay 3 months with one or more of the nine partners. The distribution will depend on availability and research interest. All partners that the consortium will strive in principle towards an equal distribution of the scholars.

The EMMEC course is based on experience with joint curriculum programmes in which 220 students from 14 countries participated. The summary of 2003 http://www.femp.org/Documents/course_summary.pdf contains a/o the comments of the students who participated last year.

Conclusions

The conclusions are:

- If nothing is done to join forces in education, *extinction* will follow.
- Things don't happen automatically.
- Initiative has to come from universities.
- Co-operation of universities is essential!!
- Many benefits for students.
- Industry is willing but wants to see initiatives first.

GLOBAL INDUSTRY LOOKS FOR GLOBAL ENGINEERING EDUCATION

IF WE HAD FIRST DEVELOPED IT ON PAPER WE WOULD NOT HAVE SUCCEEDED !!