CHALLENGES
TO THE CIVIL ENGINEERING PROFESSION IN EUROPE
AT THE BEGINNING OF THE THIRD MILLENIUM

Proceedings of the EUCEET - ECCE
International Conference, Sinaia, Romania, 13-17 July 2001

EUCEET

**EUROPEAN CIVIL ENGINEERING
EDUCATION AND TRAINING**

SECOND EUCEET VOLUME

Edited By
Iacint Manoliu

Proceedings of the EUCEET-ECCE
International Conference, Sinaia, Romania, 13-17 July 2001

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PREFACE

This is the second of a series of volumes to be published within the frame of the Thematic Network Project EUCEET (European Civil Engineering Education and Training) run on the basis of a grant of the European Commission under the auspices of the Erasmus component of the SOCRATES programme.

The volume contains the Proceedings of the EUCEET-ECCE International Conference *"Challenges to the Civil Engineering Profession in Europe at the Beginning of the Third Millennium",* which took place in Sinaia, Romania, on 13-15 July 2001. Since the Conference was part of the EUCEET third General Assembly, it was considered appropriate to open the volume with an overview of all EUCEET events which took place in the interval 12-17 July 2001 in Romania and then to insert the papers sent for the Conference, or presented at the Conference, which were grouped in four parts.

The valuable contributions of the authors to the Conference is highly appreciated.

Thanks are expressed to Professor Florin Dabija for his work in the revision of the papers. The efficient activity of Mia Trifu and Cristian Banciu in preparing the volume for publication is acknowledged.

Last but not least, the support given by the Technical University of Civil Engineering Bucharest deserves our deepest thanks.

Professor Iacint Manoliu

Chairman of the Organising Committee
Secretary General of the EUCEET Steering Committee

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IN SHORT ABOUT EUCEET

EUCEET (European Civil Engineering Education and Training) is a Thematic Network Project initiated in 1997 by the Technical University of Civil Engineering of Bucharest, Romania, which was approved by the European Commission in the frame of the SOCRATES-Erasmus Programme for a 3-year duration (1st September 1998 – 31st August 2001). The number of partners increased steadily, from 58 in the 1st year to 66 in the 2nd year and 80 in the 3rd year. In the 3rd and last year, the network was composed of 80 partners, from which 59 universities, 13 professional associations of civil engineers, 3 international associations and 5 research centres. The list of partners in the third year of the project is given in the Annex 1.

The main objective of the EUCEET project, coordinated by the Ecole Nationale des Ponts et Chaussées, was to enhance the cooperation between universities, faculties and departments of Civil Engineering in Europe, with the involvement of the academic and professional associations, in order to contribute to the development of civil engineering education and to increase its quality and effectiveness. To accomplish this objective, six themes were defined, as follows:

A. *Curricula in European civil engineering education at undergraduate level*
B. *Accreditation and quality assessment in civil engineering education*
C. *Synergies between universities, research, industry and public authorities in the construction sector of Europe*
D. *Postgraduate programmes and continuing professional development in civil engineering*
E. *Innovation in teaching and learning in civil engineering education*
F. *Demands of the economic and professional environments in Europe in respect to civil engineering education*

At the first EUCEET General Assembly, which took place at the Universitat Politecnica de Catalunya, ETSECCP Barcelona, on 22-23 February 1999, three Working Groups were formed and were assigned the themes A, B and C. At the second EUCEET General Assembly, which took place at the Engineering College of Odense, on 18-20 May 2000, three new Working Groups were formed for the themes D, E and F.

The reports of the Working Groups A, B and C, as well as a comprehensive presentation of EUCEET activities in the first two years (1 September 1998 – 31 August 2000) and a paper on civil engineering in the context of the European higher education area, formed the object of the first EUCEET volume, published in early 2001.

The 3-year activities of the EUCEET project culminated with the third EUCEET General Assembly organised in Sinaia, Romania, on 13-17 July 2001, which incorporated the EUCEET-ECCE Conference *"Challenges to the Civil Engineering Profession in Europe at the Beginning of the New Millennium"*.

A BRIEF PRESENTATION OF ECCE

ECCE (European Council of Civil Engineers) was created in 1985 through the common belief among European civil engineers that they are better placed to advance Europe's built environment and protect its natural environment by working together. EU institutions now recognise ECCE as the most powerful single voice for the civil engineering profession in Europe. ECCE members are the professional civil engineering associations in European countries. The current membership is made up of members from Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Poland, Portugal, Romania, Russia, Slovenia, Spain, Turkey and United Kingdom. ECCE was among the founders members of EUCEET.

Since the 29th ECCE meeting held in June 1999 in Dublin, ECCE members have been regularly informed about the development of EUCEET activities. A Task Force was created to cooperate with the EUCEET Working Group F.

THE OPENING SESSION OF THE EUCEET-ECCE CONFERENCE

The opening session of the EUCEET-ECCE Conference took place on Friday 13 July 2001. The Conference was open by Prof. **Iacint Manoliu** from the Technical University of Civil Engineering Bucharest, Chairman of the Organising Committee and Secretary General of the EUCEET Steering Committee.

Here are excerpts from the opening speech of Prof. Manoliu:

"Tomorrow is 14 July, the National Day of France, for which we congratulate our French friends, present in great number at this Conference. But 14 July is an important date for EUCEET, too. It was on 14th July 1997 that an agreement was signed in Barcelona among the partners of the Tempus project CESCOOP – meaning Civil Engineering School Cooperation, coordinated by the Technical University of Civil Engineering Bucharest. The agreement expressed the willingness of the partners to found the network EUCEET and to submit to the European Commission the application for a project. Prof. Marie-Ange Cammarota, on behalf of the Ecole Nationale des Ponts et Chaussées, kindly and courageously accepted to assume the difficult task of coordinating the project. Four years after that day and less than two months before the end of the 3-year contractual period of the project, we should express our gratitude to Marie-Ange Cammarota for her outstanding job, for her endless devotion for the EUCEET cause.

Since 1996, when Thematic Network Projects started to function within the SOCRATES-Erasmus programme, more than 45 such projects were approved by the Commission. However, it is interesting to mention that EUCEET is the first and so far the sole network devoted to a major engineering field. Perhaps this is not by chance. Construction industry represents the largest industrial sector in Europe. Civil engineering is, no doubt, the engineering field in Europe which bears the greatest responsibility for ensuring the quality, safety and the overall sustainability of the built environment and for protecting the natural environment. The dialogue between academic institutions, public authorities and professional associations is of paramount importance in this field, more than in any other engineering field.

The Thematic Network EUCEET was meant to be a forum for such a fruitful dialogue. EUCEET found a most reliable partner for accomplishing this goal: the European Council of Civil Engineers – ECCE, which was among the founders members of EUCEET.

One of the EUCEET Working Groups "Demands of the economic and professional environments in respect to civil engineering education", was operating also as a Task Force of ECCE. Our Conference is an excellent opportunity for the EUCEET Working Group F and for the ECCE Task Force to present the results of the activities undertaken and to discuss them with the distinguished representatives of the academic and the professional worlds.

Challenges to the civil engineering profession in Europe are, indeed, great at the beginning of the new millennium. We truly hope that the Conference, through its lectures, papers and discussions, will put into evidence some of his challenges and define ways to meet them.

The Conference is an intrinsic part of the third and last EUCEET General Assembly which will continue until Tuesday 17th July.

Paris, Barcelona, London, Torino, Dresden, Bratislava, Lyon, Porto, Odense, Prague, Budapest, Thessaloniki, Trondheim, all are part of the EUCEET geography, places where various EUCEET meetings took place since the inception of EUCEET activities in December 1998. Now, is the turn of Sinaia or, better to say, of Romania. We are very happy and proud to host this final event of the 3-year EUCEET Project which might represent, why not, a new beginning in the cooperation between major actors of the civil engineering community in Europe."

The participants were greeted by Prof. **Petre Pătruț**, Rector of the Technical University of Civil Engineering Bucharest, who said:

*"The project of Thematic Network EUCEET (**Eu**ropean **C**ivil **E**ngineering **E**ducation and **T**raining), initiated and actively supported by our university, had as main objective to emphasize at European level the most important directions of development of civil engineering education. Attaining this goal involved the activity carried out in close cooperation by 80 partners from 25 countries, among which there were 59 prestigious European universities where civil engineers are being trained.*

In a period when there is a clear tendency toward harmonization of higher education systems in Europe, EUCEET partners have brought a remarkable contribution to make clear the true rapports between immobility and progress, between tradition and innovation, between the civil engineer as a specialist and the civil engineer as a factor of social progress. Over the centuries the civil engineering profession has represented, through its results, both a challenge and a triumph of the human mind. The theme of this conference represents a challenge by itself.

There is a challenge to analyse and think of the directions of development of this noble profession, which only few centuries ago used for its computational needs just elements of arithmetics and geometry; it eventually passed successfully to utilisation of mathematical analysis and, nowadays, to extensive use of informatics. All these efforts aimed at making new constructions able to challenge more and more the heights, the gravity laws, the seismic-generated forces, in order to provide more safety and more comfort to people.

Besides regulating factors existing in a market economy, a decisive role in shaping up the profile of the civil engineer in the third millennium is assigned to higher education, including the structure and the content of educational process in this field.

Specialists from all the countries participating to the programme of EUCEET Thematic Network have had the opportunity to compare curricula plans and to examine the actions taken towards reform and modernisation of the educational process. Similar trends and options have been found, all of them converging towards achieving compatibility within civil engineering education in Europe. Regarding from a broader angle, the phenomena of globalisation raise new problems for technical higher education, including civil engineering one; accordingly, European countries are looking for new forms of "articulating" their education offer to certain extra-continental educational systems.

European universities involved in the training of civil engineers face nowadays certain acute problems to whom they are obliged to adapt quickly, such as:

- *identification of new sources for financing the educational process;*
- *polarisation in university campuses of the scientific research activities related to constructions and construction materials, with subsequent creation of technological, innovation and business parks;*
- *strong informatisation of the training process of future specialists;*
- *provision for the construction market of specialists with differentiated competences – execution of works and, respectively, conception/design – by permanent adaptation of the content of educational programmes to its necessities;*
- *increase of training exigencies in connection with the quality in constructions and with the relation between constructions and environment;*
- *development of the systems for continuing education, et al.*

The Technical University of Civil Engineering Bucharest is strongly connected to these modern requirements; an eloquent confirmation of the results obtained so far in establishing its compatibility with the European civil engineering education is represented by the accord regarding "double diploma" signed few months ago by our university and the prestigious Ecole Nationale des Ponts et Chaussées of Paris.

The technical higher education must face permanently future challenges, such as keeping a "positive" balance between tradition and innovation, as well as between theoretical and practical-technological training of future civil engineers.

Of course, the objectives of EUCEET Thematic Network were not to prepare "unique formulas" for civil engineering training at European level. However, I do have the conviction that all the discussions and exchange of opinions that took place during the development of this project have led to a "natural assimilation" of the factors of progress identified in the educational programmes subjected to analysis.

I am also confident that the activities to be carried out at the present conference will offer the possibility to identify new requirements and new aspirations that will challenge the civil engineer in the third millennium. The technical higher education should consider them very seriously, professionally and with abnegation. I wish a complete success to the Conference and, closing my speech, I would like to address congratulations to its organisers and, particularly, to our distinguished colleague professor Iacint Manoliu, president of the Council for Cooperation and Relations of the Technical University of Civile Engineering Bucharest."

On behalf of the Union of the Association of Civil Engineers of Romania and of its President, Prof. Panaite Mazilu who due to health reasons could not be present, the Conference was greeted by Dr. **Traian Ispas**, Vice-President of the Union, who said among others:

„Our Union, an ECCE member since 1996, has a permanent preoccupation for promoting a harmoniously developed natural environment and for contributing to the socio-economic progress of our country.

We think that today, by the number of the countries represented and by the interest it takes more especially in harmonizing the regulations in the field of constructions, ECCE is a most powerful voice for the profession in Europe.

The presence at this conference with a symbolic title „Challenges to the Civil Engineering Profession in Europe at the Beginning of the Third Millennium", of a large number of participants demonstrates the major interest of the economic and the professional communities in the training of civil engineers.

We consider this conference as an opportunity for discussing and disseminating information in the universities and professional societies for all the participants from European countries and, as host country, as a possibility to inform you "in situ" on the problems the Romanian economic and professional environment in the construction field is confronted with and to make you know the real and profound Romania, with its aspirations and its difficulties but also with its optimism and its wish for progress at the beginning of the 21st century."

In the welcome address pronounced on behalf of the European Council of Civil Engineers, Prof. **Antonio Adao da Fonseca**, ECCE President, stressed that ECCE is committed to achieving uniformly high standards of technical competence among European civil engineers by formulating agreed guidelines for education and training. In the domain of professional development and recognition, ECCE aims to establish compatibility between the different regulations controlling the profession throughout Europe and to achieve mutual recognition and protection of national qualifications, with the objective to ensure that the status of European chartered civil engineers is universally acknowledged world-wide. ECCE was fully supportive of EUCEET and established a Task Force to enhance its involvement in the activities of the Working Group dealing with the relationships among the professional and the academic worlds.

Concluding his address, Prof. Antonio Adao da Fonseca said:

"Dear Colleagues, I want especially to thank and to congratulate Prof. Marie-Ange Cammarota, the coordinator of the EUCEET, and Prof. Iacint Manoliu - Chairman of the Organizing Committee for their work towards the successful accomplishment of EUCEET objectives.

ECCE has the highest expectations from the EUCEET work. As a matter of fact, we follow after you, so we profit a lot from what you do.

As president of ECCE, I wish this conference and the EUCEET General Assembly the greatest success and to express to the Technical University of Civil Engineering Bucharest, in the person of its Rector, Prof Petre Pătruț, and to the Union of Associations of the Civil Engineers from Romania, in the person of its Vice-President Dr. Traian Ispas, our warmest gratitude."

Addressing the Conference, Prof. **Radu Damian**, Secretary of State at the Ministry of Education and Science, said:

"On behalf of Mrs. Ecaterina Andronescu, The Minister of Education and Research of Romania, I would like to welcome you to this very important conference of the Thematic Network EUCEET.

Now I will try to say a few words, and I am also trying not to let myself be carried away by the fact that I am also a graduate of Technical University of the Civil Engineering Bucharest and express some views as I am supposed to do it from my present position of Secretary of State for higher education and European integration in Romania.

In this perspective, the importance of this European Thematic Network is seen as a major contribution to the decision makers, to the policies in the education in engineering profession in the European countries.

You know that higher education and educational systems in general are in a period of a perennial change. We are living in this new millennium and we have a lot of challenges in front of us and, of course, the civil engineering profession, as it was said before, has a major role to play. From this view point, the results of the discussions on the important topics you have in the programme, will be very important as contributions to ministries of education in our countries, in all European countries participating in this important meeting; we speak about reshaping education, about Bologna process, about Salamanca Recommendations, the Prague Communiqué and all these must be seen as a process in which the profession should play a very important role.

As you know, not so many ministers of education have an engineering formation, so it is for engineers to say their word and try to contribute to correct and right decisions for our profession. I am very confident that this European Thematic Network - and I have to praise the European Commission as well, for having approved funding this important network in civil engineering - will be a great success and I am very confident that you will have good results.

On behalf of the Ministry of Public Works, Transportation and Housing, the Conference was greeted by Mr. **Ion Stănescu**, Director-General, who said:

"I am very pleased to be here with so many distinguished colleagues to this International Conference "Challenges to the Civil Engineering Profession in Europe at the Beginning of the New Millennium".

The Ministry of Public Works, Transportations and Housing was set up to produce a really significant improvement of the living standards of the Romanian people.

The main actions, to be undertaken by the Ministry are the following:

- *re-launching and encouraging the construction activity and the improvement of the housing conditions in Romania;*
- *improvement of the technical regulations for design, execution and use of the constructions, aiming at increasing the safety and comfort of their users;*
- *rehabilitation of the existing houses and transportation infrastructure;*

- *diversifying of the new houses;*
- *improvement of the life conditions in the villages;*
- *encouraging and simulating the construction of social and cultural facilities especially gyms for the young people;*
- *long-term plans for sustainable development of the national territory and their harmonization with the programmes and strategies aiming at European integration.*

The national housing strategy is based upon:

- *improvement of the ratio between the market cost of a dwelling and the average family income;*
- *access to an acceptable dwelling for those who cannot meet the free market requirements;*
- *facilitating the private investment process.*

The national territorial development plan, the general urban development plans and the local town planning regulations will represent the main elements aiming at the economic development of the human settlements; at the same time, regional development studies for cross-border areas and regional territorial development plans will be prepared in order to serve as prerequisites for regional development plans.

To accomplish these objectives, the Ministry cooperate with professional associations and technical universities in order to develop civil engineering education.

Many members of these associations and universities take active part in technical commissions for disaster prevention, technical regulations, accreditation and professional recognition.

The distinguished representatives of the professional world share their rich experience and assure the necessary exigence.

The new millennium in our profession means: new technologies, new construction materials, new essential requirements. The construction industry continues to merge and consolidate – this is an ongoing and non-reversible process.

I wish great success to the Conference works."

In the break following the opening session, participants gathered at the entrance of the Conference hall for a group picture.

THE TECHNICAL SESSIONS

The Technical sessions of the EUCEET General Assembly and of the EUCEET-ECCE Conference covered the six themes of the EUCEET project, assigned to the Working Groups A….F.

The programme of each session comprised a General Report of the respective Working Group, one or several theme lectures, the presentation of a number of papers and discussions.

The General Reports of the Working Groups A, B and C were included in the first EUCEET volume published in 2001, while the General Reports of the Working Groups D, E and F will form the object of another EUCEET volume to be published in 2002.

The lectures and the papers are included in this volume.

THE ROUND TABLE: EUCEET CONCLUSIONS AND PERSPECTIVES FOR FUTURE COOPERATION

The EUCEET General Assembly in Sinaia, which included the EUCEET-ECCE Conference, ended on Tuesday 17th July 2001 with a Round Table. Moderator was Prof. Iacint Manoliu and participants: Prof. Marie-Ange Cammarota, Ecole Nationale des Ponts et Chaussées, Prof. Jose-Luis Aracil, Universidad Politecnica de Madrid, Prof. Laurie Boswell, City University London, Prof. Josef Machacek, Czech Technical University, Dr. David Lloyd Smith, Imperial College London, Prof. Giuliano Augusti, University "La Sapienza" Roma and Prof. Günther Heitman, Technical University Berlin.

In the first part of the Round Table, Prof. Iacint Manoliu presented a summary of the EUCEET Dissemination Project, for which the application was sent to the European Commission on 1st March 2001[1].

The main goal of the Dissemination Project is to distribute the outcomes and products of EUCEET to the entire civil engineering academic community in Europe as well as to the professional associations, public authorities, construction companies, research centres a.s.o. The main envisaged outputs of the dissemination project are:

- publication and dissemination of two new EUCEET volumes;
- organisation of three EUCEET Regional Fora, open to project partners and to new partners, in order to discuss matters concerning civil engineering education in Europe in the light of the EUCEET findings and of the transformations occurring in the European space of higher education;
- presentations on EUCEET at councils, conferences and workshops to take place in 2001/2002, with both national and/or European character.

Of major importance are the three EUCEET Fora. Each Forum is foreseen as a one and half-day Regional Conference, with attendance primarily from the host country. The format proposed for such a Conference will include dissemination reports of the six EUCEET Working Groups, contributions from the participants, a Workshop on Recommendations and Conclusions of the 3 + 1 year project EUCEET and a Round table on the future of EUCEET actions. The three Fora, to be hosted by Madrid, Gliwice

[1] Eventually, on 12th September 2001, Ecole Nationale des Ponts et Chaussées was officially informed by the approval of the application, for the one-year dissemination project, starting on 1st October 2001 and terminating on 30th September 2002.

and Munich, will take place, tentatively, in May 2002, June 2002 and, respectively September 2002.

Participants at the Round table expressed their views on the EUCEET cooperation and outcomes. The proposal formulated by Prof. Iacint Manoliu for a new project, called EUCEET II, for a 3-year duration, starting on 1st October 2002, was unanimously endorsed. From the discussions which followed, valuable ideas emerged, to be used in the pre-proposal for EUCEET II, due to be sent to the European Commission by 1st November 2001.

SOCIAL ACTIVITIES

Participants at the EUCEET-ECCE Conference who arrived in Bucharest on Thursday 12th July 2001 were invited by the Organizing Committee to a dinner at the Scientists' House (also known as Assan House), a true architectural jewel, built in 1906 by the famous Romanian engineer, industrialist and explorer Bazil George Assan, who donated it before the second world war to the Romanian Academy.

On Friday 13th July 2001 in the morning, the trip by bus to Sinaia was preceded by a sightseeing tour of Bucharest which included the visit of the Parliament Palace, the second largest building in the world.

In the same day, in the evening, a Welcome Reception was offered to the participants at the Conference in the main hall of the "Casino" in Sinaia.

On Saturday 14th July 2001, after the sessions of the Conference, the Dance Company "Oleg Danovski" from Constantza, famous on a world wide scale, presented a Ballet show which was greatly appreciated by the participants.

The official diner of the Conference, which followed after the Ballet show, gave to the participants the opportunity to express the most sincere congratulations to their French colleagues for the National Day of France.

On Sunday 15th 2001 in the afternoon, a visit of the Peleş and Pelişor Museums in Sinaia took place, enabling the participants to discover the beautiful castles built in the last decades of the 19th century by Charles I of Hohenzollern, the first King of Romania.

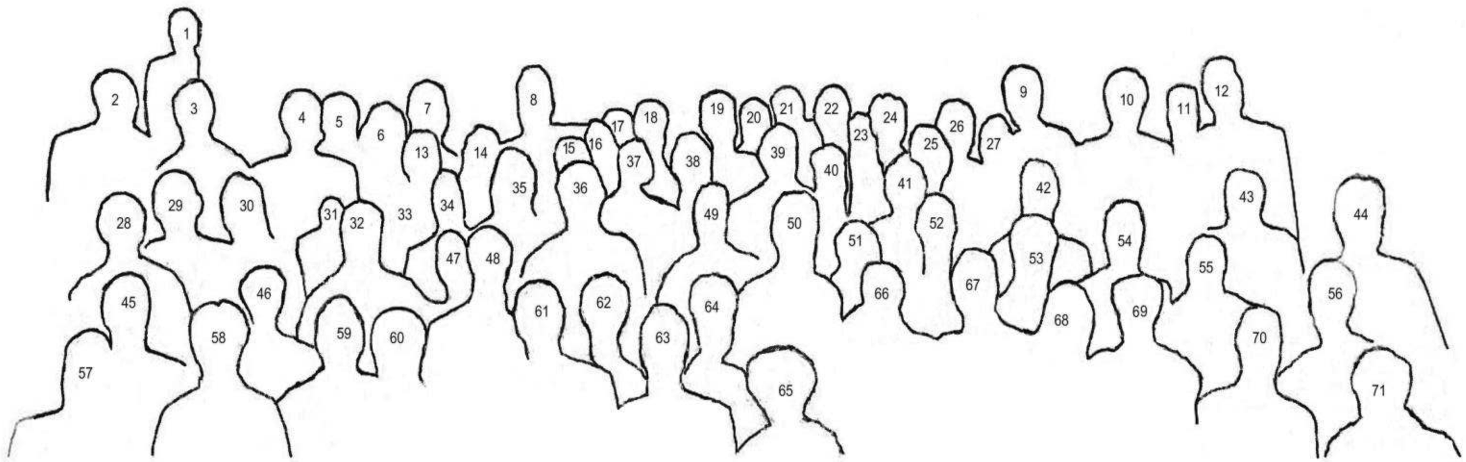
In the afternoon of Monday 16th July 2001, participants at the EUCEET General Assembly travelled by bus to Braşov, main cultural and industrial center in the South-East part of Transilvania. After a short visit of the Old Square of Braşov, the trip continued to Poiana Braşov, a summer and winter resort at 1,100 m altitude where, in the fabulous setting created by the surrounding mountains, a Romanian dinner was offered.

PARTICIPANTS

The EUCEET-ECCE Conference was attended by 98 participants from 22 countries. The list of participants is given in the Annex 2.

WORDS OF ACKNOWLEDGEMENTS

In the closing session of the General Assembly, which followed to Round table on Tuesday 17th July 2001, Prof. Iacint Manoliu expressed warmest thanks to the team of collaborators: Prof. Nicoleta Rădulescu, Secretary General of the Organising Committee, Prof. Sanda Manea, Assoc. Prof. Tudor Bugnariu, Assoc. Prof. Loretta Batali, Assist. Prof. Andrei Olteanu, Teaching Assistants Manole Şerbulea and Ernest Olinic, Graduate students Lavinia Ştefan and Andrei Popescu and the members of the technical staff: Mia Trifu, Laurenţiu Sonia, Alina Rancea, Cristian Banciu and Ramona Iordache.



1. LEGAIT Amaury, 2. WHITWELL John, 3. STRAGYS Vincentas, 4. Bulgaria, 5. DICKY Josef, 6. MOREL Andre, 7. SERTLER Hynek, 8. MIZZI Jean-Paul, 9. BRATTELAND Eivind, 10. DAMIAN Radu, 11. SANDI Horea, 12. Ion Stănescu, 13. ? , 14. BREABĂN Virgil, 15. MISTEAR Bruce, 16. KURAAZ Vaclav, 17. BOSWELL Laurie , 18. FISCHINGER Matej, 19. SUAREZ Benjamin, 20. MACHACEK Josef, 21. POLLOK Jan, 22. JUAN-ARACIL Jose Louis, 23. FRANK Roger, 24. Jacques Beranger, 25. VILA ANTON Gabriela, 26. TRINKS Caroline, 27. SECO E PINTO Pedro Simao, 28. MAJEWSKI Stanislaw, 29. MATERNA Alois, 30. BUJNAK Jan, 31. RĂILEANU Paulică 32. LOVAS Antal, 33. ? , 34. ? , 35. ? , 36. LAUR Toomas, 37. ISPAS Maria, 38. PANĂ Gheorghe, 39. ? , 40. KOWALCZYK Ryszard, 41. REIS Antonio Jose, 42. POP Gabriela, 43. ? , 44. BUGNARIU Tudor, 45. LLOYD-SMITH David, 46. KERR Colin John, 47. KOUKKARI Soile Irmeu, 48. LATINOPOULOS Pericles, 49. ANGELIDES Demos, 50. HANNINEN Seppo, 51. ? , 52. ISPAS Traian, 53. AHRENS Carsten, 54. DABIJA Florin, 55. GILEWSKI Wojciech, 56. LAPKO Andrzej, 57. DIMOIU Iuliu, 58. KWAN Alan, 59. MIHĂILESCU Mircea, 60. BARON Gerard, 61. MANOLIU Iacint, 62. ? , 63. ADAO DA FONSECA Antonio, 64. LEAL LEMOS Luis, 65. CAMMAROTA Marie-Ange, 66. HANNINEN Seppo, 67. LOJANDER Matti Hermanni, 68. STEENFELT Jorgen, 69. HEITMANN Gunter, 70. RĂDULESCU Nicoleta, 71. LO PRESTI Diego

Representatives of EUCEET, ECCE and Construction industry in a picture taken in front of the Conference Hall. From right to left: Iacint Manoliu, (EUCEET Secretary General), Marie-Ange Cammarotta, (EUCEET Coordinator), Dereck Polock (Chairman, Halcrow Group. Ltd. UK), Anton Adao da Fonseca, (ECCE President), Nicoleta Rădulescu (EUCEET Executive Board member) and Gheorghe Pană (Halcrow Romania)

EUCEET PARTNERS

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School of Civil Engineering Nottingham

UNIVERSITY ASSOCIATIONS

Association of European Civil Engineering Faculties
International Association of Civil Engineering Students

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PROFESSIONAL ASSOCIATIONS

INTERNATIONAL
European Council of Civil Engineers

NATIONAL
Ceska Komora Autorizovanych Inzenyru a Techniku Cinnych ve Vystabve
Cyprus Council of Civil Engineers
Conseil National des Ingenieurs et des Scientifiques de France
Zentral Verband Deutscher Ingenieure
Technical Chamber of Greece
Institution of Engineers of Ireland
Consiglio Nazionali degli Ingegneri
Ordem dos Engenheiros
Uniunea Asociațiilor Inginerilor Constructori din România
Colegio Oficial de Aparejadores y Arquitectos
Colegio de Ingenieros de Canales, Caminos y Puertos
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PART ONE

Demands of the Economic and Professional Environments in Respect to Civil Engineering Education

THE EUROPEAN CIVIL ENGINEER OF THE 21st CENTURY

António Adão da Fonseca[1]

***Abstract**: The paper outlines the main attributes of the civil engineer of the 21st century in order to fulfill his responsibilities towards the built and the natural environment and to gain professional and social recognition.*

In the city of Rome, in May 2000, the General Committee of the European Council of Civil Engineers approved unanimously the Code of Professional Conduct for European Civil Engineers. Indeed, a Code of Professional Conduct for the 21st Century.

The Preamble of the Code states that:

- the purpose of Civil Engineering is to improve living conditions for humanity, always safeguarding life, health and property;
- a Civil Engineer is a servant of Society and a promoter of culture and quality of life; and
- a Civil Engineer must survey and analyse the demands of the present and anticipate future developments.

The Code is organised into five chapters, set in order of importance. First, comes “the Society”, second, comes “the Environment”, third, comes “the profession”, fourth, comes “the Clients and the Employers”, and last, comes “the other Civil Engineers”. This is a major change from the recent past, when professionals tended to value first their professional positions and interests. In the 20th Century, prestige and salaries were regarded increasingly as measures of achievement. In the 21st Century, the quality of the service given to Society, promotion of culture and achievement of quality of life will be the measures for success and for recognition. Prestige and better pay will follow from those values.

Therefore,

- ECCE is concerned with the professional environment, the professional standards, and the role and involvement of Civil Engineers;
- ECCE is attentive to the demands and expectations of Society;
- ECCE is committed to culture and quality of life for all humanity; and
- ECCE is aware of the responsibilities and duties of European Civil Engineers towards both the built and the natural environments.

[1] President of the European Council of Civil Engineers
Professor of Bridge Design at the University of Porto, Portugal
Bridge Consultant in AFA – Consultores de Engenharia, SA

This is achieved by:

- High standards of ethical behaviour
- High technical standards of the profession
- Information
- Understanding of diversity

All these objectives are to be achieved in a changing professional environment, which should be recognised in the evolution of the construction industry, in the globalisation of all markets, in the concentration of business, in the free movement of people, in the demand for safeguards of the environment, for safety and for quality of life, and, last but not least, in the direct involvement of Society in any decision-making process, clearly amplified by the media and by the powerful information channels of the present, and even more of the future.

A wide and very comprehensive scientific background in mathematics and physics should be the sound foundation of any European Civil Engineer of the 21st Century, just as it was in the second half of the 20th Century. However, in the 21st Century, communication skills and capacity for decision-making will set the difference.

Communication in the 21st Century is mostly achieved by means of computers and knowledge of several national languages. The English language is becoming the international language, but no communication is complete and truly rewarding if it is not combined with good personal relationships. And for that, the knowledge of the local language is essential. Then, full trust, pleasure and success can be achieved.

In a World increasingly conscious of the limits of its resources, decision making is very dependent on cost and efficiency. Therefore, the European Civil Engineer of the 21st Century is required to have a fundamental knowledge of microeconomics, finance and accountancy.

But most important of all, a CIVIL ENGINEER is a professional acting on PUBLIC TRUST. And trust requires the HIGHEST ETHICAL BEHAVIOUR. Civil Engineers will then regain the status of “builders” of a better future, and professional and social recognition will be granted.

CHALLENGE FOR THE CIVIL ENGINEER IN 2001: A WORLD TO SERVE

François Gérard Baron[1]

***ABSTRACT**: As many other professions facing rapid changes, the civil engineering must appraise the main trend for the new century. At European level, these main trends are considered to be: effects of policy harmonisation, globalisation, concession or build-and-operate procedures, evaluation of social demand, changes in research practice. The perspective of civil engineering profession should be investigated from the viewpoint of technical knowledge, environmental issues, quality management, risk management, new information technologies, as well as legal aspects. In order to be truly perceived as a profession turned towards the future, civil engineering must concentrate upon developing a solid education (academic, research and development practice, CE and CPD), as well as on essential skill requirements: managerial, social, ethical and political.*

1. INTRODUCTION

When choosing the title of this lecture, I feared that it could be a little provocative. Indeed Civil engineering is one of the oldest profession in the history of the world; Civil engineers were already serving the society in the antic Rome when they were building roads, bridges, water supply.

In France, the oldest school of civil engineers – l'Ecole des Ponts et Chaussées – has been founded in 1747 by Louis XV.

More recently, during the 19 th century, civil engineers have played a key role in the urban sewage systems and the railroad networks.

However, civil engineers are nowadays facing a real crisis of identity and the profession is no longer considered attractive by the new generation. Among the drawbacks assigned to civil engineering:

- the poor image and relatively low salaries;
- the rapid changes of practices;
- the new demand of society;
- the effects of globalisation.

Universities question more and more the profession on their future needs in terms of knowledge and academic curriculum when, often, the profession is unable to foresee the mid and long term of their requirements.

As many other profession facing rapid changes, the civil engineering must appraise the main trends for the new century.

[1] ECCE Vice President

2. THE MAIN TRENDS

As far as the developed countries are concerned, the main trends of the civil engineer profession is concerned may be the following :

2.1 Effects of the European harmonisation

The European Commission has issued quite a great number of directives where civil engineering is concerned. Particularly, they rule matters dealing with energy, pollution, waste and materials.

2.2 Globalisation

The global village effect entails a rapid concentration of companies. In France, as an example, several mergers have led to the two first contractors in the world – VINCI and BOUYGUES – when LAFARGE was taking the leadership of the cement industry. Theses companies are working more than 50 % abroad.

In the same time, universities were establishing more and more international partnerships.

2.3 Concessions and BOT

The procedures of launching large projects in infrastructure have everywhere moved to concessions in the French system or BOT (build and operate) in the Anglo-Saxon world. In both cases the result is a transfer from public to private.

2.4 Evolution of the social demand

The last twenty years have seen a dramatic increase of the social demand, in environmental matters, security, as well as quality of life. This demand has been boosted by the medias.

2.5 Changes in research practices

The latest trend is due to the influence of the European Commission and led, as a result to more call of tenders for research programmes on National and European levels.

3. THE CIVIL ENGINEER AND HIS FUTURE

3.1 The technical knowledge

The civil engineer has emerged for a long time from the pioneer era where empirism was largely the rule. Despite being seen as a traditional profession coming from the time of the cathedrals, civil engineering addresses now to the most advanced technologies in materials, science, modelling and processing.

This does not imply the civil engineers to all be scientists but to be able to integrate these various technologies in their job.

At the same time, civil engineers have to prove their ability to innovation. It is a proven fact that during several centuries, civil engineers have been leaders in innovation.

Indeed, civil engineers must be present in research as well as in innovation. Research aims to provide new knowledge or solutions without direct link with the market while innovation is the application of a new idea with reference to the market. The fertilisation of these two processes is required.

The European Commission is launching an area of research in which the civil engineering sector may find his place. Let me just remind that the construction sector represents 10 % of European GDP, 12 % of the European jobs and only 1 % of the budget dedicated to research.

Research and innovation cannot be avoided to increase the competitiveness of European builders. It is also a way to give a better image of the profession to young students and convince them that civil engineering is a job “high tech”.

As an example, France has invested many years in research and innovation in road construction. As a result, its contractors have become world leaders in that sector with firms such as COLAS or EUROVIA.

Besides technical fields, innovation may also be met in processes, project management or financial procedures.

3.2 The environment

3.2.1 Environmental matters

Environmental issues are playing a major role in the civil engineering profession.

Firstly, civil works have most of the time a significant effect on landscapes and nature. It involves as well the human environment and the quality of life. More and more the civil engineer is asked to find a proper compromise between the economic constraints and the protection of the environment.

These new criteria have to be taken into account aside of the technical issues. The civil engineer must be prepared to include them in his presentation of the projects to the public. He must learn to listen to the various associations as well as to the city council members. It implies more modesty and sense of human relationship.

They must also be able to present their projects to the public or to the medias with not only technical assessments.

3.2.2 Sustainable development

The concept of sustainable development enlarges the issue of environment to the future. We must learn how to be the guests of the others and leave the host house improved by our stay and even more by our departure.

This topic is specially important in civil engineering which is a large consumer of space, energy and materials. Infrastructure works are also influencing the way of life for a rather long period in the future. It implies that the civil engineer always design for the longest term.

It is a proven fact that civil engineers are not familiar with the environmental issues when experts in these disciplines are lacking of knowledge in technical and financial matters.

In order to smoothen the dialogue between the two, the civil engineer should increase his background in the knowledge of environment.

3.2.3 New skills in the built environment

Environment and sustainable development should not only be seen by civil engineers as constraints but as a source of new jobs for them. Many opportunities can be found in energy, urban development, transports, waste and depollution.

3.3 The quality management

Quality management is now compulsory in all sectors of industry. However, civil engineering is probably one of the field where the quality management is the most difficult to implement due to the number of participants, the various aleas (climate, soil conditions,...).

The quality management includes security, health and safety, environmental security. It implies that all the chain of participants to the construction process are involved in the quality management.

3.4 The risk management

3.4.1 Security

A decrease of the risks and an improvement of security has become a real social demand. Fatality is no more considered as an excuse.

This demand is a serious issue for civil engineers, since the collapse of their works may have large consequences amplified by the media.

The civil engineer, used to act in the framework of risk evaluation, must now take into account that the public talks in terms of zero risk. The famous principle of carefulness may also concern civil engineering. The liability of civil engineers is more and more raised.

In this field, the civil engineer has a key role to play to correct some of the wrong ideas spread within the media.

3.4.2 Financial risks

Civil works are more and more developed through sophisticated financial plans. Civil engineers must be prepared to appraise the financial risks of their projects.

The example of the Channel tunnel proves that a technical success may lead to financial failures.

3.5 The new information technologies

More than in any sector, the new information technologies bring dramatic changes in a profession which is characterised by the number of actors and their geographical distance.

In the civil engineer daily work, these technologies offers many opportunities:

- full information about rules, codes, materials, etc
- information exchanges (drawings, files, products, services…)
- continuous learning services

Besides, the supply procedures may change dramatically thank to e supply and on line call of tenders.

3.6 The legal aspects

Recent years have seen an increase of legal cases between the building actors about quality as well as financial matters. Therefore, civil engineers are more and more involved in the legal aspects of their work.

The Anglo-Saxon system is prevailing in more and more building contracts. Within this context, the trend is to subcontract more and more tasks and to keep inside the contractor the management, legal and financial functions.

The civil engineers must be prepared to play a role in the contract procedures in order not to let this tasks only to the lawyers.

4. CIVIL ENGINEERING: A JOB FOR THE FUTURE

4.1 Education

As in many other sectors in industry, the civil engineer must be prepared to undertake five or six different jobs during his career. Therefore, his education must be based on three stages:

- a solid academic education which must allow him to adapt properly to several changes during his professional career;
- a practise in research and development in order to allow him to understand this area when at managerial positions;
- a continuous education through programmes of life long learning.

4.2 Skill requirements for the future civil

Skill requirements of the civil engineer have increase rapidly during the last twenty years. One may summarise them as follows:

4.2.1 Managerial

- to understand the basic functions and sequences of management such as gathering data, planning, organising and evaluating progress;
- to apply systematic processes to effectively analyse problems and make cogent decisions;
- to listen to and understand the ideas of the others;

- to persuade and motivate;
- to deal with conflict;
- to counsel and advise;
- to understand the principles of financial control;
- to be able to evaluate basic financial indicators such as return on investment, present worth and discount value;
- to understand the make-up of a company report;
- to appreciate the pros and cons of different management styles and organisations.

4.2.2 Social

- to recognise the changing needs of society and to be innovative in addressing them;
- to co-operate with other professions in the development of useful innovations;
- to express one's ideas clearly in speech and in writing;
- to understand and speak other languages;
- to work successfully in a team;
- to collaborate internationally;
- to be aware of and recognise social and cultural differences between nations.

4.2.3 Ethical

- to advance technology for the benefit of human welfare;
- to ensure technology is not harmful to people and the environment;
- to conserve material and energy resources;
- to continue to learn and develop professionally;
- to act fairly to others and give credit where it is due;
- to be honest and impartial in professional matters;
- to warn of adverse consequences of professional advice not taken.

4.2.4 Political

- to be attentive to public opinion;
- to explain technology to the public honestly and in understandable terms;
- to participate in public debate on technical issues;
- to distinguish between honest criticism and that based on a vested interest;
- to examine impartially alternative solutions to controversial engineering proposals;
- to co-operate in the development of international codes and standards.

I hope that this short presentation will convince you that civil engineering is more than ever a profession turned towards the future.

PROFESSIONAL PRESSURES IN THE RECRUITMENT AND DEPLOYMENT OF CIVIL ENGINEERING EXPERTISE IN EUROPE; A CONSULTANCY VIEW

Derek John Pollock[1]

ABSTRACT: *The paper is written by a consulting engineer who leads a 3,000 plus firm. He draws on this experience to enable Central and Eastern European challenges to be put in the context of wider industrial and geographical pressures on the provision of services. Potential actions to address issues identified are suggested.*

1. INTRODUCTION

This paper is written by a native of Ireland (which was economically backward 35 years ago) who is Chairman of a consultancy employing over 3000 people world-wide with a major international engineering presence in 70 countries, and in most European countries. The paper looks at some of the economic issues across Europe in broad terms and the way they drive the needs in engineering professionalism and expertise. At the World Economic Forum in Davos recently, a Minister of a European country advised the Engineering and Construction Forum that "*you have made the world what it is by your efforts in the last 4,000 years*". However, the author believes the challenges in the next 100 years in Europe are many times greater than those that have been faced in the last 4,000 and this paper addresses some of them as they relate to Central and Eastern Europe.

2. THE EUROPEAN CHALLENGE

There are few parts of the world where there are such variations in culture, sociology, geology and political perspective. This rich mix is very attractive in certain contexts, but when delivering services across a range of countries provides a great challenge. Romano Prodi stated "*it is my ambition to make Europe the easiest place in the world to do business*" (February 2001). In a global context Europe is unlikely, in the medium term, to be able to export manufactured goods consistently unless there is considerable quality built into them. This issue of quality also impacts upon the environment and the engineering education and professionalism of those people who seek to work in that field. At the World Economic Forum meeting in Davos in 2000, 75% of the business people present thought that the environment would be the biggest single influence on their business in the future. Europe, in the main, is composed of

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[1] Dr., Chairman, Halcrow Group Ltd, multi-disciplinary consultancy

countries with common borders, so common issues of infrastructure in terms of transport, river basin management, air quality, water quality, need multi-country action. The paper will give examples of projects promoted to encourage issues of this nature to be tackled. Considerable emphasis will be given to the need to aim for high quality solutions in an environmental sense.

3. THE ENGINEERING EDUCATION CHALLENGE

In some ways Central and Eastern Europe want to do in 10 years what other parts of Europe have taken 50 years to achieve. To do this needs a very particular set of skills of people working in engineering. In the consulting world a modern engineer needs to be able to communicate easily, have high quality inter-personal skills, be financially literate, be very mobile, capable of utilising a wide range of software, able to support the consultation process with the public in the promotion of projects, and have an ability to work with people of different professions, including environmentalists, chemists, lawyers, financiers and those involved in closely promoting projects. Multi-lingual talents in Europe will be at a premium, unlike other major markets.

The United Kingdom experience is that there has been a fall in the number of students studying engineering and furthermore a higher percentage of engineering graduates are choosing not to go into engineering. Since 1994 there has been a 40% reduction in civil engineering entrants. This may be because of the high level of services as a percentage of GDP and the attractions of competitor professions in finance and industry, etc. Across Europe it must be assumed that, given the funding from Brussels and the major infrastructure investments that need to be made in many Central and Eastern European countries, demand will increase considerably. It can also be assumed that the economic development which will grow, along with the development of the infrastructure, will also increase demand. Whilst some of the qualities described as being necessary for an international consultancy may not be necessary for individuals working in all the countries of Europe, striving towards those qualities will add benefit to the countries where they live and work. In the United Kingdom it has been estimated that the exporting activities of UK consultants is valued at about £Stg 2.5 billion per year to the UK economy. Between 1960 and 1997 approximately £Stg 23 billion worth of engineering consultancy has been sold outside the UK. This services market is one which tends to grow as economies develop and many countries in Europe may see the opportunity to take part in activities beyond their borders and, indeed, outside Europe.

4. HOW ARE WE COPING WITH THE CHALLENGES?

A brief review of some of the recent projects undertaken by Halcrow in Central and Eastern Europe over the past 5 years gives a picture of the wide range of skills and methodologies which are increasingly required from infrastructure consultants, in addition to the more traditional design-based skills. A common thread that links many of these projects is that they have required a number of less traditional skills for engineering consultants, to achieve sustainable, environmentally acceptable, and financially viable infrastructure, or environmentally protected natural resources. These are the areas that should receive growing attention for civil engineers' education in the future.

- Environmental Support Facilities were established for all EU Accession countries between 1994 and 1996, through the Phare programme, with Halcrow advice. We also led an international programme for '*Widening of the Environmental Action Programmes*' in the New Independent States (NIS) of the Former Soviet Union between 1998 and 1999, identifying environmental projects, preparing them for investment, and providing associated training. *A Phare Environmental Project Preparation Facility* and a programme for *Developing Implementation Strategies for Approximation in Environment (DISAE)* between 1996 and 1999 were important programmes that involved a great deal of trans-national understanding and co-ordination. These environmental projects also required a detailed knowledge of EU environmental policy objectives, management and administration skills, and technical advice. In each case, partnerships with local consultants were critical to successful implementation.
- Between 1998 and 1999, technical assistance was provided in the regional programme for enhancing water quality in the Danube River Basin. This involved a great deal of international co-operation and organisation to introduce catchment area policies. Technical as well as administrative and organisational skills were all important.
- Identified European Transport corridors have been the main focus for investment in roads, rail and port infrastructure. Between 1999 and 2000 the consortium we led assessed the costs and benefits of compliance with EU legislation in developing this infrastructure. Separately, our in-house railway group assessed the requirement for intermodal transport links on Transport Corridors 2 and 9. These projects required skill in producing economic feasibility and transport planning studies, combined with the ability to make comparisons and sustainable solutions across several international borders.
- The introduction of private finance is an inevitable conclusion to the shortfall in available public sector funds, if the projected level of transport and environmental infrastructure is to be achieved before EU accession. Halcrow has frequently worked with several private sector concession companies, to assist in traffic studies for motorways (in Hungary and Poland), or provide regulatory or due diligence support to investors for water utilities, and are currently involved in introducing new forms of contract, modelled on the UK *Design Build Finance and Operate (DBFO)* model for road rehabilitation and management in Poland. Knowledge of how private finance can be introduced, regulated and managed is of growing importance.

- Knowledge of how to maximise access to EU funding programmes – in particular the ISPA (Instrument for Structural Pre-Accession) applications, has been a prominent feature of Halcrow's recent activity in Romania. Our application for ISPA funding for the new wastewater treatment facilities at Iasi (completed earlier this year), in particular, was held up by EU officials to be the best example seen so far, and a model for future applications. These applications require a combination of economic cost-benefit justification, together with technical and environmental compliance with EU standards (known as *'Aquis Communitaire'*)
- Regional development policies and plans are being developed as a natural extension to the decentralisation process, following regional reorganisation. Halcrow provided training and advice to the new regional 'voivodships' of Poland in 1999 and 2000, to facilitate their access to EU, International and private finance for regional development plans.

We adopt an approach to each individual country; a one-fit solution to meet needs across many countries is not possible. In Halcrow we encourage people from many countries to join us. Every Halcrow employee has an opportunity to buy shares in the company and enjoy the benefits of that share ownership. We believe that a marriage of strong technical skills, local design codes, with international expertise will provide attraction to clients in Central and Eastern European countries. It will also benefit national engineers in developing careers. We intend to develop strong local companies employing high quality nationals backed up by our global expertise, especially with regard to procurement, management, project financing, technical and research and development. With significant investment we have, as our vision, the idea of "one Halcrow", even though it is over 3,000 people strong and spread around the world. To enable this team to provide swift and accurate services to many clients, all of our team are linked by an intranet. We recognise that the knowledge in a company like Halcrow, which is over 130 years old, resides in the brains and experience of the people who provide project and design help to clients. We have created the Halcrow University on our intranet site to ensure that best practice and ideas are available to all Halcrow people, wherever they work, 24 hours a day, 7 days a week.

In any particular country, we choose to co-operate with the best local engineering practices, so that our mutual clients can benefit, not only from local experience, but international competence track record and quality.

But where are we going to get enough people to join our networks? We believe we have to raise the impact of our company, which is why we have www.halcrow.com where many potential joiners visit us. We set high entrance standards and UK graduates have a 2 day screening process to test individuals, not only on their technical, but inter-personal skills. We aim to be a high profile supplier of training and are an employer of choice well beyond the field of engineering. In some recent years we have spent more on training than the profits made by the company, because we recognise that although we may have sophisticated systems, it is individuals and their skills and enthusiasm which deliver best services and projects to our clients.

To encourage the engineering profile, we have vacation students, make lectures to schools, participate with universities in research and development work and have many visiting Professors (linked to specific universities). We encourage staff to present papers to academic institutions, give prizes for this, record professional success, and provide support to professional institutions.

To enable many other organisations to contribute effectively to projects we have a number of collaborative project web sites. In effect these enable many parties to contribute to project development in a virtual project office. Obvious advantages exist where design standards and business systems are compatible. Travel can be cut and skills deployed more efficiently and rapidly and environmental benefits gained.

If we assume we can get the appropriate people, or develop the appropriate networks, to do the engineering, how can the projects be supported financially? The sort of projects being referred to are those of a significant nature, often associated with environmental clean up, or transportation improvements. In Central and Eastern Europe a significant portion of projects of this nature will be supported by funds from Brussels. There are specially designed pump priming programmes to enable loans and even injection of capital to be had. Institutional funding from IFIs around the world is also applied into Central and Eastern Europe. Organisations with international experience in PFIs and a global network of contacts can help in project identification and promotion.

In Europe the firm has much experience in public/privately funded projects so that colleagues have amassed and developed expertise on projects currently worth in excess of $US 7 billion. This expertise is being used to help funders, insurers, governments, constructors and operators.

Experience shows that when successful pump priming is achieved then other sources of money, probably in country, become available to promote projects. A further stage is where private sector money from beyond country boundaries is confident enough to invest in projects in country.

Many engineers in parts of continental Europe have been used to working with taxpayers' money (IFIs/Government, etc) and, indeed, that remains a substantial expenditure for most countries of the world. However, working on projects where private money from beyond country boundaries is involved is a challenge of an entirely different nature. In these circumstances engineers need to have qualities not often developed in engineers of the recent past. An example of a project of this nature would be the UK's Channel Tunnel Rail Link. The author's firm was involved in preparatory works on this project for at least three years before the project really got going. Although a consulting business, and therefore having relatively small equity base, Halcrow was able, using its intellectual capital, to be part of the shareholding of the company which won the concession to build the £Stg 3 billion project. The project is now backed by the European Investment Bank funds. The engineers from Halcrow who are involved in this project had to undergo very considerable learning processes and are put under pressure from time to time by the nature of the risk sharing which is ensuring quality and cost benefits to the client.

A key issue in the promotion of a project like this and, indeed, in much of the work which colleagues currently undertake is the need to deliver in some "*best value*". The UK National Audit Office targets are to reduce defects by 20%, time by 10%, costs by 10 to 30% (NAO January 2001). It is recognised that in many parts of Europe there is fragmentation of the industry which provides the infrastructure needs. Recent work in the UK is addressing this by producing single teams, including clients, designers and constructors. This has an impact on personal behaviour and workshops are regularly held to improve teamworking across businesses. The needs of transparency where projects are publicly funded puts a new set of requirements on these projects. Experience with UK Government departments suggests that a system of measurement to enable clients to be certain that the appointed teams are not only delivering the product, but working to quality, personal development and financial norms. I believe that some of these ideas may help in projects in Central and Eastern Europe as the market develops.

5. CONCLUDING REMARKS – THE BIG ISSUES AHEAD

There will be enormous demands on engineering people right across Europe in the coming decade. As a continent Europe needs to have a view as to what characteristics it can support and develop in the context of other major groupings in the world, such as the United States, China, and the emerging countries of Asia. I believe that a high quality environment to support the existing rich cultural diversity is an obvious ingredient; engineers must be prepared to respond. The European Council in Lisbon set itself the goal of making Europe the most competitive, dynamic and inclusive knowledge-based economy in the world during this decade.

If these visions are to be achieved in a wider context, in Europe the physical infrastructure work will be both large and quite rapid. Issues of language, standards, portability of skills and transparency of process will need to be addressed. Changes will occur.

In a recent large business leadership study a set of common drivers for change over the next 3 years were identified:

- Economic and financial;
- Technological;
- Political;
- Structural;
- Education.

For Central and Eastern European engineers this means that some key issues must be faced:

1. The requirement for engineers to become more politically and intellectually aware. Accession to the European Community will require a number of demanding social, political and economic changes and the engineering community must play a key part. For example, the World Bank report on Romania identified that 40% of Romanians live below the poverty line – educated and skilled homegrown engineers are

part of the solution, as a strong environmentally sound infrastructure will help deliver the economic benefits. The $1.5 billion support expected from the IMF will help spur this development on.

2. Businesses in engineering must adapt and be prepared to:

- Build a wider partnership focus and develop strong links with educational institutions, including financial sponsorship;
- Be agile and be prepared to change internally to adapt to the demands of young aspiring engineers (male and female) or lose them to other industries;
- Support industry actions towards increasing the number of qualified engineers; investment in skill and innovation is a critical success factor in the information age;
- Create value added networks using the key strengths of parties. In this context we aim to encourage knowledge transfer into our offices and share information with local companies we work with. A company objective is to create opportunities for many nationalities to contribute, not only at home, but also as part of teams internationally.

We work in many countries across Europe. We have active projects in 10 countries of Central and Eastern Europe, as well as managing a framework contract with EU for infrastructure. We are in the process of developing networks and transferable skills. In a broader context the Institution of Civil Engineers (London) has identified issues in its Agenda for the Future. Environmental pressures and conflicting demands of communities and transport are to the fore.

3. Institutions and educational communities must work collectively with governments and industry to:

- Focus resources and educational assets on producing engineers able to address national and trans-national priorities;
- Revise academic offerings to become focused as centres of excellence, understanding that the economic environment and the stretch of resources are finite and increasingly demanding;
- Prepare joint development plans with business and government, and be prepared to find new ways of funding programmes that have clear business outputs in the community.

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EDUCATION OF CIVIL ENGINEERS IN VIEW OF DISASTER PREVENTION. THE CASE OF EARTHQUAKES IN ROMANIA

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***ABSTRACT**: The place of seismic risk among risks affecting Romania is referred to. The size of seismic risk is discussed and illustrated. The shortcomings of earthquake risk reduction activities and the obstacles to risk reduction are mentioned. The negative influence of the current stage of economic, social and cultural development of the society is referred to. The importance of improved education at all scales, as a main way to improve the current situation, is emphasized. Some main directions in which the education of civil engineers should be improved in order to cope with the challenges of seismic risk are discussed.*

1. INTRODUCTION

Romania is prone, as any region, to disaster occurrence. The disasters can be, of course, of natural or of anthropogenic origin. The direct experience of Romania strongly confirms the fact that among the potential, suddenly occurring natural disasters, the most severe are due to earthquakes. This does not mean that other natural disasters are not important. On the contrary, natural disasters due to flooding occurred quite often during last decades. Landslides, often induced by flooding or by changes of water table etc., occurred rather frequently too. The impact of flooding and of landslides was nevertheless much milder and easier to manage than that due to major earthquakes.

This paper deals only with the disasters having some connections with the professional activity of civil engineers. Among them, particular attention is paid to potential earthquake disasters, due to some significant features:

- the sudden and unpredictable occurrence of earthquakes, the destructive ones included;
- the likelihood of quite frequent occurrence (several times during an average human lifetime, at least for the zones affected by the highest seismic hazard, which cover a significant part of the Romanian territory);
- the size of their impact (which means at the same time the direct, immediate effects, as well as the long lasting, more or less indirect effects), as well as the fact that their suddenness makes it practically impossible to efficiently react during the shaking time;
- the state of art of human knowledge, which makes it possible to analyze much more thoroughly seismic risk and to develop technical measures of disaster prevention, than in case of other categories of disasters, and which is building models of interest in order to cope with other categories of disasters.

The paper is devoted mainly to problems raised by seismic risk and by the activities aimed to control and reduce it. The outcome of the evaluation performed is not optimistic. It turns out that the task of controlling and reducing seismic risk is rather

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unlikely to yield significant positive results in the short, or even medium, term, and this is due to the existence of several categories of obstacles, out of which one which is usually neglected is represented by the current limits to knowledge and know-how. On the other hand, there are many people who think that the single unlimited resource available to mankind is learning. The author pertains to them. Education and learning can provide individuals and communities with skills and powers to which it is hard to pre-establish limits. It is the single hope to cope with problems which can seem otherwise to be insurmountable.

2. THE STAKE INVOLVED BY SEISMIC RISK IN ROMANIA

2.1 General

Seismic risk is a multi-faceted entity. This is mainly because of the variety of elements at risk, of potential effects of earthquakes, of potential chains of events etc. This means that risk analysis should be performed at a highly comprehensive scale, which is usually out of the reach of practice. Further data and comments are related therefore just to some basics, concerning mainly seismic hazard, impact of previous earthquakes and some features of risk.

2.2 Some data on the seismic conditions of Romania

The territory of Romania is affected by several seismogenic zones. The seismic hazard is described in simplified terms by the zonation maps included in the standard [19] and in the design code [20], and reproduced in Figures 1 to 3. The two approaches adopted in these regulations are quite equivalent.

The Vrancea, intermediate depth, seismogenic zone [*VSZ*] is by far the most important seismogenic zone in Romania. According to [1], it releases more than 95% of the seismic energy released per century in Romania. Some crustal seismogenic zones (Banat, Fagaras, Southern Dobrogea etc.) are important at a rather local scale, since they may affect quite limited areas and the magnitudes of earthquakes generated there are lower. The *VSZ* affects important parts of the Romanian territory, which are the most populated and include the capital city, Bucharest.

The recurrence of Vrancea earthquake (Gutenberg-Richter) magnitudes is characterized by return periods of about 6 years for $M = 6.0$, 14 years for $M = 6.5$, 30 to 35 years for $M = 7.0$, 120 to 180 years for $M = 7.5$, while the limiting magnitude was estimated [7] to lie between 7.8 and 8.0. In fact, earthquakes with $M \geq 7.0$ occurred three times (in 1940, 1977 and 1986) during the 20th century. The recurrence of *MSK* intensities in Bucharest, as analyzed in [16], is characterized by return periods of about 10 years for I = VI, 20 years for I = VII, 50 years for I = VIII, 200 to 300 years for I = IX. In fact, Bucharest was hit twice (in 1940 and 1977) by intensity VIII during the 20th century.

To complete the data on seismic hazard, it is to be mentioned that forecasts on new major earthquakes were made recently. A first forecast, in rather qualitative terms [2], estimated the time of occurrence of a next major Vrancea earthquake for 2004 $\pm$ 4 years. One of the authors of that forecast subsequently estimated a somewhat later occurrence time (after 2005). A forecast made in probabilistic terms [15] showed following occurrence windows with 60% probabilities: a time window (>2001, <2013) and an M_{GR} magnitude window (≥6.8, <7.6). Similar expectation appears for a new strong earthquake in the Fagaras seismogenic zone. The earthquake catalogues at hand [1, 3] put to evidence a high cyclicity for strong Fagaras earthquakes with magnitudes in the range M_{GR} = 6.0…6.5 (return period of 80 to 85 years), while the most recent strong event (M_{GR} = 6.5) took place in January 1916, with an instrumental epicentre in the area of the reservoir of the tallest dam of Romania (the 165 m tall Arges- Vidraru dam).

2.3 Elements at risk and their vulnerability

Like in any modern society, the examination of the Romanian society and infrastructure puts to evidence the existence of an ensemble of various elements at risk: people, buildings, engineering structures, networks and lifelines, various industrial facilities, as well as less tangible elements representing information, various functional systems etc., among which some are critical. Some of the elements at risk are connected with secondary hazards, especially in case of facilities including high risk sources, with an important potential of pollution of various kinds, of generation of severe fire or blast or of heavy flooding (especially large dams).

The seismic vulnerability of various categories of elements at risk is known at different degrees of certainty and accuracy. It may be stated that the best degree of knowledge was achieved to date for the residential building stock. This is due to the direct experience of impact of strong earthquakes, as well as to the state of the art of engineering knowledge. An extensive post-earthquake survey of the performance of buildings was undertaken subsequently to the 1977 earthquake. More than 18,000 buildings were investigated in Bucharest [1]. The results on their vulnerability, detailed for eight classes of buildings, were summarized in [9]. Based on these results, on results from literature and on regression analysis, some analytical expressions were proposed for the vulnerability of buildings [13, 14]. Considering the case of residential buildings, which represent, obviously, a category of elements at risk of highest importance, one may emphasize the considerable difference that exists between various categories of such buildings. Their vulnerability depends upon the period of construction (which was determinant for the design philosophy), the materials, the type of loadbearing structure, the height and, of course, upon their actual state, as determined by phenomena of corrosion etc. and by the occurrence of successive strong earthquakes, which inflicted cumulative, apparent or hidden, damage. The experience of the 1977 earthquake showed that the most vulnerable category is that of relatively tall buildings (about 8 to 12 storeys tall) built during the pre-second world war period. The main causes of their high vulnerability are:

- the lack of concern of design engineers for earthquake protection;
- the often poor material quality;
- the cumulative negative effects of the successive earthquakes referred to in the introduction;
- the effects of corrosion, sometimes of fatigue due to urban traffic too;
- inappropriate interventions undertaken sometimes by occupants;
- the tendency to resonance, during strong earthquakes.

28 out of the 32 buildings having collapsed in 1977 in Bucharest pertained to this category. There is a consensus that, in case a similar earthquake strikes again, more cases of collapse are bound to occur. This category of buildings is not the single one to

be more vulnerable than acceptable. Several categories of residential buildings, designed according to the code in force during the pre-1977 period do not meet the requirements of the code currently in force [20] and this is strongly correlated with the data of post earthquake surveys, which put to evidence damage, sometimes heavy, inflicted by earthquake action.

There are also other elements at risk which appear to be highly vulnerable. There are several industrial facilities, some of them including high risk sources (especially related to potential heavy pollution of various kinds) that are not in a satisfactory condition. Corrosion due to the particular environment that can be met at various places in industry is one reason. Other reasons may be related to fatigue, to overloading due to malfunctioning of equipment (cranes, machines etc.), to poor quality of construction works etc.

2.4 Implications for seismic risk

As it is known, seismic risk results as a consequence of seismic hazard, seismic vulnerability and exposure of various elements at risk. It is hard to attempt at having a global, even rough, estimate of seismic risk affecting Romania, but it can be mentioned that a consensus exists among professionals about the likely impact of a future strong earthquake: in case an earthquake like that of 1977 (which can be considered a highly representative scenario earthquake) strikes again soon, its impact would be more severe than that witnessed in 1977. There are several reasons for this situation:

- several categories of residential buildings are in a poorer condition than on the eve of the 1977 event (main reasons: the cumulative effects of the strong earthquakes underwent meanwhile, as well as of corrosion).,
- the ability of the state to control and concentrate various kinds of resources in order to react under emergency conditions has decreased.

An attempt to analyze the risk affecting existing buildings was made in [14]. Probabilistic tools were used and a parametric analysis was performed for seismic conditions like those of Bucharest. Alternative assumptions were considered for the nominal level of earthquake protection and for the duration of exposure. The model used for the stochastic processes related to hazard and risk was Poissonian. The outcome of these analyses showed, among other things that, in case pre-second world war tall buildings are left as they are, without undertaking measures to reduce their vulnerability, for decades to come, the risk of collapse goes into the range of tens of percents. This conclusion, since it is in quite good agreement with the experience of the 1977 earthquake, when the 28 buildings having collapsed represented about 7% of a stock of about 400 buildings of this category, is most alarming.

The possibilities to assess the risk affecting other categories of elements at risk are more modest, first of all due to the very limited information on their inventory and on their vulnerability. A main source of information in this respect is given by the experience of the 1977 earthquake. This experience shows, among other, that chains of events did not play a major role in relation to the physical damage to various elements at risk. On the other hand, it is likely that overall indirect economic effects were considerably more severe than what would correspond to the official estimates of somewhat more than $2 * 10^9$ US$, given at the end of 1977. The balance of foreign trade was seriously upset after 1977 and this might be due, to an important extent, to the decrease of exporting capabilities after the earthquake.

3. MEASURES TO REDUCE SEISMIC RISK: ACTIONS AND SHORTCOMINGS

3.1 Some references to the activities devoted to earthquake protection and to shortcomings met

Knowledge in the field of earthquake engineering was as good as absent during the pre-second world war period. The effect of this situation was illustrated by the toll of the destructive earthquakes of 1940 and 1977 in Bucharest: a high-rise r.c. structure collapsed in 1940 and 28 high-rise buildings built during the pre-second world war period collapsed in 1977. The impact of that earthquake was the first to raise the concern of governmental institutions and of engineers, for earthquake protection.

The totalitarian regime ruling up to 1989 was generally reluctant to admit public discussion on the seismic risk issue. Even the concept of risk was more or less banished. Several achievements of that period should be, nevertheless, acknowledged. Basic knowledge on earthquake engineering was spread, and the codes and standards developed were not far from the international requirements of that time. Romania became, scientifically and technically, well developed in this field. Only two residential buildings built in Bucharest during the post-war period underwent (partial) collapse in 1977 (the Railway Computer Center, having an r.c. structure, which was totally destroyed, must be added to them). After a rather short period of hesitation following the 1977 earthquake, the government was quite efficient in mobilizing resources needed for coping with emergency problems. Several favourable circumstances should be mentioned: the government had the leverages to easily mobilize all the available resources; the general degree of discipline was rather high; an important free buffer residential room was available (and used for hosting homeless people or occupants of some of the buildings which required radical intervention measures); and the national economy was not in a particularly bad shape.

The governments succeeding after 1989 were much more open to free discussion on earthquake protection problems, as well as eager to undertake measures aimed to reduce seismic risk. In the aftermath of the 1990.05.30 event (M_{GR} = 6.7, no collapses of buildings), the governmental decision 644/1990, aimed at supporting accumulation of information, evaluation of buildings and interventions, was promptly endorsed. The governmental decision 486/1993, aimed at dealing with problems related to seismic risk affecting facilities including high-risk sources, was issued. Another governmental ordinance, 47/1994, was issued, in line with the goals of IDNDR and establishing a general frame for disaster prevention. The governmental ordinance 20/1994, (updated and broadened in 1999), is related to strengthening of vulnerable buildings too. The law 10/1995 referring to construction quality was endorsed. The governmental ordinance 67/1997 requires local authorities and juridical persons
to: undertake an inventory of buildings in order to identify buildings to be evaluated; undertake an inventory of buildings to be evaluated; evaluate buildings; develop a program of strengthening vulnerable buildings. The updated ordinance 20 referred to was aimed at providing owners lacking own resources (i. e. those earning less than the average income) with the financial resources required for intervention. It may be also mentioned that seismic zonation and design codes were updated [19, 20]. Unfortunately, the necessary financing of all the activities oriented towards earthquake risk reduction, as tackled in the documents referred to, remained a wish.

Activities aimed at reducing seismic vulnerability and risk were undertaken in numerous cases after the 1977 event and after the following ones. There are positive examples of interventions which definitely reduced earthquake vulnerability for various buildings, engineering structures etc.. It is nevertheless more important to emphasize several negative aspects related to those activities.

First of all it should be mentioned that a comprehensive strategy and program of earthquake risk reduction was not developed yet. Second, actions undertaken were rather the result of local initiatives of owners or occupants (be it the case of public buildings, of hospitals, of residential buildings etc.) or of requests of some occupants. In case one considers the various categories of residential buildings, one can remark that pre-war buildings were tackled on an individual basis and no standardized solutions (even if designed) were put into practice to date to counteract the shortcomings observed especially in the case of more vulnerable post-war high-rise buildings built according to standardized solutions.

Obtaining funding for interventions on existing buildings was always difficult, due to the state of the national economy. It may be mentioned, nevertheless, that there were cases when these funds could not be used, due to managerial/logistic shortcomings (e.g.: the reluctance of occupants to agree with the temporary evacuation of buildings, required in some cases by the adoption of radical strengthening solutions). In some cases when, in agreement with regulations referred to, funds could be provided for the lower income occupants, the occupants with incomes beyond the established threshold for assistance, could hardly find a source for borrowing money needed for strengthening apartment houses.

The identification of intervention priorities was sometimes hampered by the outcome of engineering evaluations of building vulnerability. The methods of evaluation, which relied basically on the methods prescribed by codes for the design of new buildings, led often to too pessimistic conclusions on the ability of buildings to withstand earthquakes, distorting thus priorities (sometimes those conclusions were in direct contradiction with direct observation, even of instrumental nature, provided by the experience of the strong earthquakes of 1986 and 1990). In addition, the bodies responsible for the safety of several important facilities, including high risk sources, now in operation, showed little readiness to support reanalyzing of the seismic conditions specified decades ago for design, at a time when knowledge on seismic hazard was much more limited. Several analyses performed more recently put to evidence the serious hazard underestimates having occurred in the past.

Given this situation, the author believes that the factors creating the current environment will not cease to act in the near future and that the pace of activities needed for improving the control and reducing the seismic risk will not be quickly improved in a spectacular way. On the other hand, as far as one refers more specifically to the risk generated by the existing building stock, it is most likely that rehabilitation and strengthening activities will not advance at a satisfactory rate, such as to make possible in the short or medium term a spectacular risk reduction. To put it differently, it can be said that what was made wrong during the 20th century (especially during the inter-war decades) cannot be corrected within a few years. Therefore, from this viewpoint, the main way to reduce risk is represented by the gradual replacing of the part of the existing stock that is affected by high(est) risks, and this requires, of course, time.

In spite of the pessimistic view presented, some measures proposed to be urgently adopted, and made operational, [5], are referred to further on. It may be stated that the adoption and implementation of these measures would require neither important costs, nor a long time and that their adoption would be most beneficial from the viewpoint of earthquake protection goals.

1. Development of a program of inventory, preliminary classification and evaluation of elements at risk, in agreement with the tasks foreseen for every holder or caretaker of various elements at risk. A Government decision should update and adapt the provisions of some previous decisions for various sectors of activity (this should include the obligation to develop a network of databases for the results of inventory, classification and other related activities).
2. Preparation and urgent endorsement of regulations aimed at supporting evaluation activities and, if necessary, proper intervention, upon: public buildings held by central agencies; essential facilities (e.g., some medicare facilities, firemen units, schools etc.); and facilities including high risk sources etc.; ensuring of course also appropriate financial mechanisms required for this purpose.
3. Urgent identification of residential buildings affected by the highest risk of collapse in case of incidence of an earthquake similar to those of 1940 and of 1977, and effective intervention upon them within a period of 3-4 years.
4. Development of a program for putting out of operation (temporarily or definitively) of industrial facilities affected by a high risk, due to the current state of corrosion, upon which the holder cannot urgently intervene.
5. Development of a program of evaluation and, if necessary, of design of solutions of intervention upon repetitive structures proven to be unsafe.
6. Development of well correlated criteria of urban planning and of intervention upon the existing building stock in connection with the general rehabilitation and upgrading goals, in order to achieve an urban development under conditions of a satisfactory earthquake protection level.
7. Development of an insurance strategy aimed at assisting holders of buildings and other structures to undertake earthquake protection measures.
8. Development of a program of earthquake preparedness aimed to ensure prompt and efficient reaction in the event of a strong earthquake (investigation of affected structures, establishing intervention priorities, provisional earthquake risk reduction measures).
9. Definition of more precise specifications and coordination of prerogatives and tasks of central agencies, in agreement with the provisions of the Government ordinance 47/1994, concerning the earthquake disaster prevention: categories of works to be surveyed (besides residential buildings, public buildings, industrial facilities, bridges, dams, nuclear facilities etc.), actions to be undertaken or surveyed, provision of necessary resources and of an appropriate legislative frame.
10. Development of detailed earthquake protection strategies for various sectors of activity, with participation of professional groups and of groups or offices aimed to implement these strategies.
11. Examination of the current stage of research and development of a program aimed to cover the current high priority needs.
12. Examination of the current stage of development of the regulatory basis and development of a program aimed to cover the current high priority needs.

The above mentioned urgent measures do not conflict in any way with the development of a comprehensive and consistent earthquake protection strategy. On the contrary, they should be integrated into such a strategy, which, in itself, is of a high priority.

3.2 Main obstacles encountered to date

The experience at hand and the examination of the causes of non-satisfactory results to date in relation to seismic risk reduction makes it possible, and also necessary, to emphasize some main causes and obstacles having led to the non-satisfactory situation referred to before.

There are definitely important obstacles of financial nature to earthquake risk reduction. While the total resources required in order to bring all existing elements at risk (first of all those for which the primary vulnerability, i.e. the vulnerability against ground motion, counts) to the level of protection required by the regulations in force for the design of new structures might reach the range of thousands of millions of US$, the resources made available yearly for risk reduction activities were during last years in the range of millions or of tens of millions of US$ (note here that, due to causes dealt with subsequently, not even these modest funds could be entirely spent in some cases). Of course, raising the earthquake protection level for all existing elements at risk to a level to fulfill the requirements of the current regulatory basis concerning the new works is practically not feasible, and it was put into practice nowhere in the world. On the other hand, the current situation, according to which important and large categories of buildings and of other elements at risk are subject to intolerable risk, is by far unacceptable, especially in case one takes into account the forecasts referred to, concerning the high probability of occurrence, in the close future, of new destructive earthquakes.

Yet the lack of appropriate financial resources cannot be by far blamed as a unique obstacle hindering these activities. It is a main point of this paper to emphasize other critical factors in this connection.

A crucial category of obstacles, routinely not referred to, is represented by the limits of various kinds to knowledge and by the reluctance to spend more resources in order to improve knowledge. First of all, there are no satisfactory databases listing the elements at risk to be tackled, in all fields in which such elements at risk exist. Then, there are no satisfactory databases on the outcome of evaluation of the relevant elements at risk. As an example, out of the more than 2.5 million existing buildings of Romania, much less than 1% were evaluated up to the end of 1999 (in spite of the demanding provisions of ordinance 67/1997, previously referred to). Moreover, there are often quite severe methodological limits concerning the ability of experts to evaluate existing works in a way to lead to results compatible with the outcome of observation of actual performance during strong earthquakes, as well as the ability to derive efficient and economical solutions of reducing vulnerability. In some way, on a complementary side, there are limits to the know-how on hazard evaluation, especially for sites of facilities raising special problems (facilities including high-risk sources, strategic facilities etc.), as referred to in the previous subsection. All this means, ultimately, that risk control is at a low level.

Another category of obstacles is represented by the shortcomings of the current legislation and regulatory basis. For example, there is no regulation for creating buffer room (which was so important and beneficial during the 1977 earthquake and thereafter) needed for people having become homeless during earthquakes or for occupants of buildings requiring temporary evacuation in order to make possible radical strengthening. There is no regulation to compel to evacuation of occupants, when radical strengthening solutions requiring this are needed. There is no regulation to provide leverage created by insurance activities in order to push owners/occupants to become active partners in risk reduction activities. The regulations related to disaster prevention activities, based on the governmental ordinance 47/1994 referred to, were not developed so that the resources of various kinds required in order to create a consistent system of operational administrative bodies to survey, coordinate and foster risk reduction activities in various fields of interest are provided. Nor were the resources required for proper action provided.

Finally, one should not neglect some categories of obstacles of less tangible nature, yet of undeniable importance. They refer essentially to the lack of appropriate willingness of various socio-economic groups involved, to surpass the difficulties and, ultimately, get risk reduced. One could state in this respect that the disaster prevention culture is not sufficiently developed. This can be said in relation to the attitude of the population as a whole, but also of specialists and persons or groups having special responsibilities. From a different point of view, there is a lack of appropriate political will, at the level of agencies or persons playing a formal role in various agencies, institutional structures etc., as well as at the level of what should be a vigorous civil society (unfortunately, ethic questions may be raised in this latter connection too). The allocation of financial resources for risk reduction depends heavily, of course, on this political will.

One can summarize previous considerations stating that not only appropriate financial resources are lacking, but also other categories of resources (knowledge of various nature, sufficiently complete and consistent legislation and regulations, managerial capabilities and general willingness) are in rather short supply. The picture of obstacles presented may be not sufficiently comprehensive or detailed, but the obstacles referred to and their critical character can hardly be denied. It provides a view on the actual size of the task of reducing seismic risk to a level not too far from the philosophy and requirements of regulations in force for new developments. The persistence of even one of the categories referred to is sufficient in order to render powerless any attempt of large scale action, aimed at risk reduction. The powerlessness will only be more dramatic in case several of the categories mentioned coexist and interact. The factors which led to the current situation, in which the risk is high and little is done to reduce it, are strong, and they will continue to exist for a rather long time in future. The author believes also that the current bleak aspects referred to are not characteristic to Romania only. On the contrary, they are determined by the general level of economic and cultural development and they are encountered everywhere where a comparable level of development meets seismic conditions of a comparable severity.

It turns out, consequently, that:

- there are no reasonable hopes for a significant seismic risk reduction in the short, or even medium, term;
- there is a quite high likelihood of occurrence, soon, of a new disaster, against which

the society will be less prepared to react than it was in 1977.

The author believes that significant risk reduction is feasible only in a longer term, provided the necessary favourable factors to support a positive evolution will be at work in a sustained way. Among other, in relation to the residential building stock, the author believes that the main way to reduce the risk affecting it at present is represented by its gradual replacement by new construction. These issues will be discussed more in depth in the next section.

4. ADDITIONAL REFERENCES TO EXTRA-TECHNICAL ASPECTS

Previous comments tackled several obstacles of a rather non-technical nature, that were, and are, hampering earthquake risk reduction activities. The importance of those aspects cannot be neglected, because they are influencing the approach to activities devoted to earthquake protection as a whole, be they technical activities related to the development of new works or to reducing seismic risk affecting the existing ones, or complementary activities devoted to the development of earthquake preparedness in a wider sense. Emphasis must be put in this connection primarily on two categories of factors: those related to the economic development and those related to cultural aspects. There is, of course, strong interaction and mutual influence between them.

A summary look at the history of earthquake induced disasters shows undeniably that heavy impact represents the toll paid due to weak societal development. The fact that, during the three destructive earthquakes occurred during the last three decades in California (San Fernando, 1971, Loma Prieta, 1989, Northridge, 1994), the toll of lives lost never exceeded the range of tens, convincingly illustrates the power of general development in preventing earthquake disasters. This is in striking contrast with the death toll in China in 1976 or in Turkey in 1999.

Romania never ranked high at a world scale from the viewpoint of economic development. In 1938, which was the year of the highest level of economic development during the pre-second world war period, the GDP per inhabitant was about two to three times lower than in advanced European countries, like France, or Germany, or Czecho-Slovakia. After the post-war period of poverty, during the time of centrally planned economy, a period of extensive development followed. In about 1970, Romania ranked thirtieth or fortieth at a world scale. Subsequently to the oil crises of 1973 and 1979, Romania followed the path of all countries with centrally planned economies, which meant dramatic gradual increase of the gap separating them from the free market, developed, economies. By now, its GDP per inhabitant is in the range of US$ 1,500 and, according to PPP estimates, it is in the range of US$ 4,500. There are numerous fields of highest economic, social or political importance, that are critical for the future of the country, for which the resources required to cover stringent needs cannot be mobilized at present.

In a different connection, but in quite strong correlation with the general economic problems, the very low current level of development of the insurance industry must be emphasized. The insurance industry is surely unable to cope with the impact expected in the case of occurrence of a major earthquake, primarily because the number of insured households is currently very low and many of the buildings located in seismic areas would be hurt simultaneously by serious damage, while the aggregate capital of this industry is very low. The insurance industry meets currently some difficulties even in coping with traffic accidents, which are quite evenly distributed in time and require low insurance premiums. Effective earthquake insurance activities under the specific conditions of Romania can only be conceived on the basis of reinsurance provided by very strong international reinsurance companies. It may also be mentioned that, according to the author's knowledge, insurance companies presently operating in Romania do not generally have the skills needed for understanding the problems raised by seismic risk.

Romania badly needs, among other, an improvement of the residential area available to the population. An improvement in this sense, if and when materialized, can represent a major contribution to the task of reducing seismic risk. In case one assumes stationary population and an average lifetime of a residential building (or unit) of 100 years, it turns out that in order to just periodically replace the buildings worn out, one needs a rate of construction of at least three apartments per thousand inhabitants and year. In order to improve the situation of the residential building stock, keeping a pace able to yield significant results within a few decades, this rate should at least double. The rate of construction was actually in the range of six apartments per thousand inhabitants and year for several years before 1990. About 60% of the currently existing building stock (five out of the eight million existing residential units) is due to construction activities that took place during the post-second world war period. Construction activities dropped dramatically after 1989 and no decent figures on construction programs, to correspond to the needs referred to, were made public to date from official sources. In case one considers a rather modest construction price of about US$ 300 per square meter of built area (a more realistic average figure would be 400), it results that an average urban type apartment of about 100 square meters will have a cost in the range of US$ 30,000. Building even only three apartments per thousand inhabitants would require thus about 6% of the GDP, while doubling that rate to a level to cover the improvement needs referred to, would require about 12% of the GDP. These are demands that apparently no economic or political factor is ready to support at present, which means that the situation is bound to worsen, while seismic risk is bound to increase, due to at least normal phenomena of aging of the building stock. This shows what expectations one may have and indicates the efforts needed for reducing the seismic risk.

The economic factors referred to must be considered also in connection with complementary factors, of a cultural nature. Civil society was never strong, at a large scale, in Romania. Its force was higher perhaps, before the totalitarian era, during the more remote past, at the level of rather small communities (especially rural communities of some parts of the country). The totalitarian regime astutely acted to destroy it, in order to reach the level of control of the society it desired. Several external observers pointed out obvious weaknesses of the civil society in all countries of the region, during the post-totalitarian period. In a different connection, the disaster prevention culture, whose development was one of the main points of activities in the IDNDR frame during the last decade of the 20^{th} century, is not well developed in Romania. On the contrary, one may encounter a rather fatalistic attitude of the population, while confronted with the risk of disasters, which it apparently recognizes. The culture of insurance against accidents of various natures, including earthquake induced impact, is also at a low level. While, during the totalitarian regime, several kinds of insurance, that of buildings included, were compulsory and in fact reinsured by the state (which considerably helped in coping with the impact of the 1977 earthquake upon the building stock), insurance activities dropped dramatically after 1989, when insurance of buildings became optional. Seeming to be cynical, which is indeed not right, one can remark that the culture of disaster prevention and of insurance can hardly be well developed in the frame of a rather poor society, where people have little wealth to defend and the apparent value of working force and, sadly, also of human life, is rather low. Therefore, the main solution to the task of controlling and reducing risk lies in the general economic and social development, that provides people with the material and cultural wealth and, consequently, enhances the motivation to control and reduce risks.

5. EDUCATION: THE MAIN HOPE FOR THE FUTURE

The author believes that the main hope for better coping with the challenge of seismic risk is represented by the improvement of knowledge and know-how, as stated at the end of the introduction. It may be concluded, therefore, that attention is to be paid in future to improving education, which is bound to lead, in the longer term, to the desired outcomes. The concern for improved education is to be considered from at least two complementary viewpoints: on one hand, as a main way to correct the shortcomings of the present; on the other hand, as a tool to be hammered out in an anticipative way, such as to cope with the challenges of the future.

The directions in which the education of civil engineers should develop, in order to cope with the situation presented, are discussed at this point. They should ideally relate to topics like:

- mastering of basic technical skills at the level of the current state of art of professional know-how and practice, but also understanding of what research activities can provide and when to ask for assistance from research;
- ability to cope with technical problems which are rather intricate and cannot be covered by the regulations in force which cover routine activities; understanding of the problems raised by, and ability to estimate, various hazards and risks; ability to develop scenarios etc., even for large scale systems (those in which disasters usually materialize);
- ability to develop efficient risk control and reduction strategies at various scales (national, sectorial, local etc.), based on a systemic approach; related to this, care and concern for ecological problems and for orientation towards sustainable development;
- mastering of managerial skills, required for tackling practical tasks in the environment generated by the current stage of development of the society and of the business world;
- ability to communicate and to interact with various specialists, institutions, authorities etc. in an interdisciplinary way;
- development of a positive civic and ethic attitude, required by the efforts to control and reduce risks;
- ability to contribute to the dissemination of the culture of disaster prevention, at various levels, from the governmental agencies to the population as a whole.

This list, even if not exhaustive, is rather comprehensive, and is also highly demanding, while it cannot be expected to be covered by a unique, compulsory, curriculum. The single way to cover it is that of developing alternative curricula, for different fields of specialization, while also taking care of providing communication bridges for specialists of various fields. Some ideas on how to shape curricula in order to answer to these needs are referred to in the following.

Mastering the basic technical skills means essentially to be able to use in practice the regulations in force. This requires, basically, to be aware of the level of knowledge which has become common in practice, to understand the provisions of the various regulations and to be informed about the regulatory framework of the field, as a whole, but also to understand the conceptual limits of the framework that covers mainly routine situations. To ensure that such requirements are satisfied, it is necessary, according to experience at hand, to considerably increase the difficulty and seriousness of the various kinds and steps of examination, counteracting the tendency of relaxation of exigency of examinations, that can be dramatically observed during last years. Coping with this challenge is not easy, given the immediate financial interests of educational institutions, to formally have many trainees, under the pressure of the bad side of the game of the market laws. As far as the market of jobs is not technically demanding and also correspondingly rewarding good skills, the trainees will always tend to look for the path of least efforts and to shun demanding institutions, curricula etc..

Routine education cannot provide the abilities required for dealing with especially intricate technical problems. To cover these needs , it is necessary to maintain and/or build small groups of experts with special skills of various natures, representing ultimately centres of excellence for selected fields. Special tasks are to be dealt with in the frame of such centres, in connection with research activities of high quality. Maintaining and/or building such centres is relatively costly and, as a rule, they are economically sustainable only in relatively richer and larger countries, where there is a strong, permanent and rewarding market for high quality expertise. It appears to be reasonable, for smaller or less developed countries, to adopt strategies of training young and gifted people abroad, as this was done in the past too. Unfortunately, this leads to a high brain drain risk, since highly skilled experts will usually find a more attractive market in rich countries. In particular, the ability to perform appropriate hazard, vulnerability and risk analyses, to develop earthquake scenarios etc., especially when dealing with large systems, represents a specific case of dealing with intricate problems as referred to above. This requires methodological skills and also creativity, availability or developing and managing of appropriate databases and networks. Coping with such tasks requires tackling several of the items listed at the beginning of the section. In particular, it requires a good understanding of the problems raised by risk analysis at various scales, the case of large scale systems included.

Developing consistent, efficient and sustainable risk reduction strategies is a task of highest complexity too. This is to rely on knowledge concerning risk problems, on the state of the art of the system of relevant elements at risk, on information about general development plans and strategies with which risk control and reduction strategies are to be correlated and, consequently, with forecasts of various relevant kinds.

Mastering managerial skills at the level required by the tasks of controlling and reducing seismic risk is particularly demanding. This requires dealing with multi-disciplinary topics, covering technical management of practical activities, know-how on providing large scale funding, lobbying the political circles of the time, even exceeding national boundaries in order to get appropriate support, to make such strategies realistic.

The ability to interact with specialists of different professions is a challenge not easy to cope with. The tradition of education of civil engineers during last decades, covering the second half of the 20th century, when training in civil engineering in a modern way was shaped (following to a high extent Soviet models), was that of quite narrow specialization. There are at present, in each institution of training in civil engineering, several faculties, between which there is little interaction and communication, while communication with education in other fields was always particularly poor. To counteract this situation, ways must be found to develop, already during the undergraduate curriculum period, a culture of trans-disciplinary communication and contacts.

The development of an appropriate civic and ethic attitude is a large size task, which is to be at work starting already with the early period of life. This means fighting the promises of corruption and the indifference towards the fate of the society, and developing the desire of being an active member of the society and to cooperate for the wellbeing of all. Of course, the engineering education must go along these general needs and develop the sensitivity to specific technical and social problems, the sense of duty for high quality work, to development of economical solutions and, perhaps above all, to provide sustainable solutions (an item that was not fashionable during the totalitarian period).

The ability to contribute to the development of the culture of disaster prevention at various levels, for various socio-economic groups, represents an important skill too, even for professionals of various fields. Given the fact that civil engineers come often in contact with ordinary people, with businessmen, with members of the administration etc., given their professional prestige, their ability to communicate is a valuable asset, since they may considerably contribute to convincing their interlocutors to adopt a philosophy and an attitude in agreement with the spirit of the disaster prevention culture.

6. FINAL CONSIDERATIONS

The paper was intended first to present a view on the problems raised by seismic risk, in the specific context of Romania. The author believes that, to a large extent, the problems raised are similar to those concerning other countries, with comparable conditions from the viewpoint of seismicity and of economic, social and cultural development, in particular those concerning the countries of south-eastern Europe. It turned out that the level of seismic risk is high and that it is quite likely that new seismic disasters, possibly more severe than those witnessed during the 20th century, will strike rather soon. A look at the causes of this unfavourable situation has shown that it is due to an ensemble of factors, which interact and enhance each other, and cannot be removed in the short, or even medium, term.

The attempt to emphasize several main obstacles to earthquake risk reduction, in the case of Romania, put to evidence the complexity of the system of such negative factors. As everywhere, high risk represents a byproduct of lack of development, from the economic, managerial, cultural etc. viewpoints. Earthquake risk reduction is basically a highly difficult, long term, task and requires continuous efforts. While general development tends to create more resources to better deal with some classical categories of elements at risk, like e.g. the residential building stock, it also tends to generate new categories of elements at risk, some of them highly vulnerable and/or prone to contribute to setting up of new potential disaster topologies, capable of creating chains of events with severe consequences in case of incidence of new strong earthquakes. As in other countries, in Romania, the major sources of risk are related to existing works of various categories, which were mostly built during many decades of the twentieth century. What was made wrong during many decades can hardly be corrected during a few years.

The Romanian school of earthquake engineering, which developed gradually during the second half of the current century, made obvious its capacity on the occasion of the 1977 earthquake, when structures designed to resist earthquakes resisted better than in many other countries for an earthquake of this size. The Romanian school of earthquake engineering also demonstrated its ability to learn from the experience of that event and of the subsequent ones. This does in no way mean that continued progress is not needed and that there are no fields for which present skills must be considerably improved in order to face the challenge of risk reduction. There is a need of continued and extended education and of continued and extended research and this should cover all fields that are relevant for earthquake protection. There is also stringent need for databases of various categories, ranging from research topics to inventory of various elements at risk, to the outcome of their evaluation. There is also a need to develop functional structures able to tackle the risk reduction tasks and the emergency tasks of post-earthquake situations.

Education, at all levels, out of which the most relevant were dealt with in the previous section, appears to be a major way for coping with the risks that affect the society at present. Education may be not cheap, but is surely cheaper than other expenditures of the society and, in the longer run, it is a most cost- effective field of investment.

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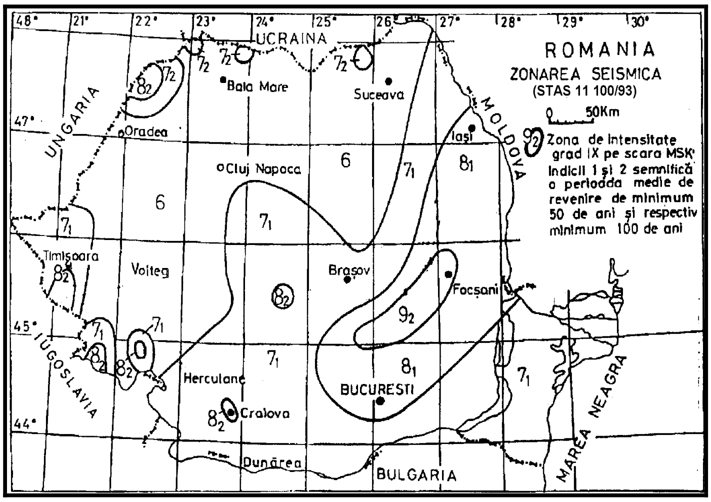

Figure 1 Seismic zonation of Romania according to SR 11 100/1-93

20. MLPAT (Romanian Ministry of Public Works): *Code for the Earthquake Resistant Design of Residential, Public and Industrial Structures* (in Romanian) P. 100-92 (Fig. 2 and Fig. 3).

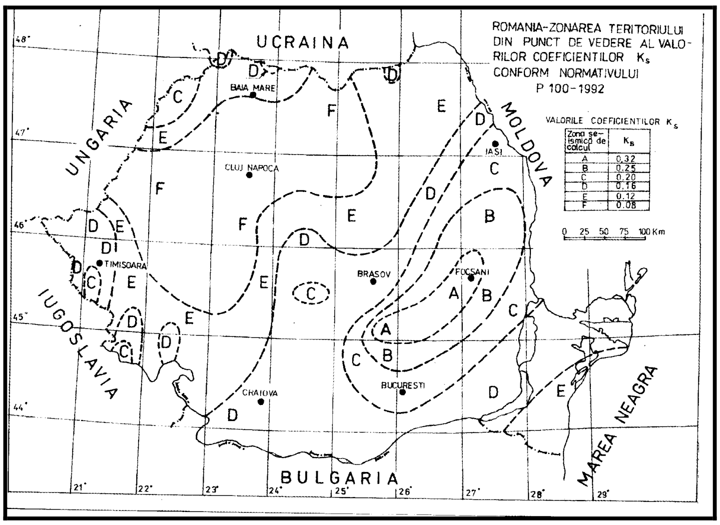

Figure 2 Zonation of Romania according to P.100-92
(as related to the basic design factor k_s)

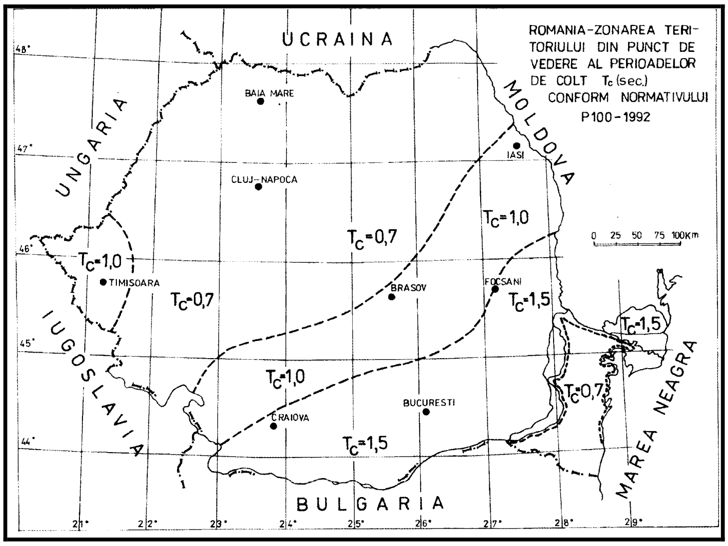

Figure 3 Zonation of Romania according to P.100-92
(as related to the corner period T_c)

WHAT EUROPEAN UNIVERSITIES CAN DO FOR THE CONSTRUCTION SECTOR

L.F. Boswell[1]

ABSTRACT*: To coordinate the training and research expertise within universities with the requirements of the construction industry would seem quite a natural process. There are opportunities within Europe for civil engineering faculties or departments of the universities to support the construction sector in both training and research/development. The paper describes some of them and outlines ideas for enhancing training schemes, taking the most important conclusions reached by the Working Group C of the EUCEET Thematic Network a step further. The main topics discussed here are: a vision for future development of constructions in Europe, exploitation of technical opportunities, enhancement deployment of knowledge and procedures, role of European universities, Teaching Company Scheme and Integrated Graduate Development Scheme (UK experience), research within the European Community.*

1. INTRODUCTION

The Construction Industry is a significant part of the European Union's economic activity and is approximately 10% of the community GDP. This activity requires enormous investment and often involves the coordination of many different technologies. Construction processes should be competitive and sustainable and, in particular, they must incorporate appropriate environmental considerations. The need for research and development, and training are implicit features of Construction Sector activities.

Within the European Union higher education system there are many Departments of Civil Engineering providing training at both first and higher degree levels. These Departments also undertake research and development activities. It would seem a natural process to coordinate the training and research expertise within universities with the requirements of the Construction Industry. Since universities are, in general, free to choose their activities, coordination may not always be as effective as possible. However there are opportunities for universities to interact strongly with the Construction Sector Some of these are described in this paper.

A general objective of the EUCEET programme was to evaluate the nature of civil engineering education throughout the European Community. In particular, Working Group C examined the links between universities and the Construction Sector. Although somewhat limited in scope, the study produced some interesting conclusions, which have been presented in the report published in the first EUCEET volume.

The objective of this paper is to take the most important conclusion of Working Group C a stage further. It has been established that there are strong interactions between the academic and construction communities throughout Europe. Although this statement may appear obvious it is now supported by quantifiable

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involvement and the details are to be found in the working group report. The paper addresses this involvement by considering the current major technical issues that concern the Construction Sector and the role that European universities might take in providing solutions by applying their expertise in both training and research. In particular, some of the opportunities that exist are discussed.

2. A VISION FOR CONSTRUCTION

European construction might well consider the following statements as the basis of an industrial vision and a framework for training and research and development activities, which encompass current major technical issues.

- High quality constructed facilities to support the competitiveness of European industry and everyone's quality of life.
- European industry is a leader in quality and economy in the global market place for construction products and services.
- The industries of construction and constructed facilities are energy efficient, environmentally benign, safe and sustainable in the use of resources, and
- Natural and man-made hazards do not cause disasters.

These statements can be summarised as a mission: to enhance the competitiveness of European industry, public safety and environmental quality through research and development, in co-operation with industry and academia, for improvement of the life cycle quality of constructed facilities. It should be obvious that European universities have a significant role to play in such a mission and that this mission embodies the spirit of Framework V as far as the Construction Sector is concerned and will continue in Framework VI.

3. EXPLOITATION OF TECHNICAL OPPORTUNITIES

There are many technical opportunities within the mission statement, which can define research and development opportunities for universities in support of the Construction Sector. These may be listed as follows:

- Information and communication technologies
- Automation in design, construction and operation
- High performance materials and systems
- Environmental quality
- Risk reduction technologies
- Performance standards system, and
- Human factors knowledge

It should be possible to recognize within the list, opportunities for the application of traditional university research and development skills. There are many schemes throughout Europe, which encourage universities to support industry.

4. ENHANCE DEPLOYMENT ACTIVITIES

The deployment of knowledge and procedures in the Construction Sector can be defined and enhanced by the following:

- The establishment of standards and practices
- Demonstration projects, and
- Education and training

It is, of course, the latter item, which most concerns the universities. This is compatible with the teaching function of universities at first and higher degree levels as well as for continuing professional development. Nowadays, the use of distance learning techniques is an area that can be exploited by universities for the benefit of industry.

5. THE ROLE OF EUROPEAN UNIVERSITIES

It would seem, therefore, that in the areas of the exploitation of technical opportunities and in the associated deployment activities, universities have a significant role to play towards solving the current major technical issues of the Construction Sector for both training and research. This role may be outlined as follows:

- Provision of formal education in Construction Sector technologies at first degree level, which may involve an element of industrial training
- Provision of enhanced higher degree taught programmes with strong industrial interaction and
- Research and development activities within the various national and European programmes.

The first item is a traditional activity and may be considered as the preliminary to the second and third items. It is within these latter two items that most opportunities exist. In what follows, some ideas have been proposed, which suggest how universities might support the Construction Sector.

6. THE TEACHING COMPANY SCHEME

An excellent example of formal collaboration between academia and industry is the UK's *Teaching Company Scheme*. The TCS is a Government funded scheme, which enables high calibre graduates to work in companies, normally for two years on projects central to the needs of the businesses and their growth and development.

Graduates are recruited to be TCS Associates by the '*knowledge base*' organizations and the companies that have agreed to work together on a TCS programme. A '*knowledge based partner*' participating in TCS may be a university or other higher education institution or private research institute organization.

TCS Associates 'own' their project within a TCS programme but are supported by experienced staff from the company and the '*knowledge base*' partner.

The aim of TCS is to strengthen the competitiveness and wealth creation of the UK by the stimulation of innovation in industry through collaborative partnerships between the science, engineering and technology base and industry.

The objectives of the scheme are:

- To facilitate the transfer of technology and the spread technical and management skills and encourage industrial investment in training, research and development.
- To provide industry based training, supervised jointly by personnel in the science, engineering and technology base and in business, for high caliber graduates intending to pursue a career in industry, and
- To enhance the levels of research and training in the science, engineering and technology base that is relevant to business by stimulating collaborative research and development projects and forging lasting partnerships between the science, engineering and technology base and business.

Over 700 TCS programmes were active in 2000 and, of course, only some of these were related to the Construction Sector. The TCS is an excellent example of good practice in the establishment of links between universities and construction enabling mutual support.

7. INTEGRATED GRADUATE DEVELOPMENT SCHEME

This UK scheme aims to enhance the present and future effectiveness of graduates (primarily engineers) in the early stages of their careers in industry by providing advanced training, based on the latest technology and techniques, which are specifically designed to meet their individual needs and those of the particular sector of the industry in which they are employed. This is achieved by the support of part-time modular masters level programmes provided by Higher Education Institutions in collaboration with groups of sponsoring companies from industry with common needs.

Typically, an *Integrated Graduate Development* programme will provide an appropriate menu of modules from which individual graduates may choose those most suited for their needs. Associated project work is carried out normally on the graduate's, "employer's" premises under joint academic and industrial supervision. Recognising the need to enhance future effectiveness of graduates, the programmes, whilst primarily technological, also cover broader issues such as management, law and technological change.

In order to ensure that the Scheme meets industrial needs as they evolve, the sponsoring companies are required to be closely involved in the design, delivery and management of the Scheme, and this may be achieved by the establishment of an industrial steering committee.

Through the provision of part-time modular courses, which have been specifically tailored to meet the needs of industry, the objectives of the Scheme are as follows:

- To encourage graduates who are pursuing engineering careers in industry and to prepare them to take on major responsibilities at an early stage in their careers.
- To deepen and broaden the knowledge base of graduates in industry to enable them to improve their professional effectiveness and recognition and, hence, to contribute towards increasing the competitiveness of industry and
- To foster collaboration between the academic and industrial sectors.

The attendance by graduates at the lectures given during each of the modular periods will involve concentrated sessions of material presentation. Thus, the periods back in industry will be used to consolidate the material given in the previous period. This is achieved by the setting of coursework.

In addition to the coursework, each graduate will be required to prepare a project. The subject of the project will be decided after discussion with the graduate. It should be realized that the distance learning nature of the scheme precludes extensive laboratory work except in very special cases. It is likely that the project would be closely related to the graduate's current work and thus reflect the integrated nature of the Scheme.

In order to satisfy the award of a Master's degree, a graduate must pass examinations and satisfy the examiners with adequate coursework and a project. Normal quality assurance procedures would be employed together with the appointment of an external examiner. The management of a particular scheme will be conducted by a local committee. This will comprise of representatives from the educational establishment, the sponsoring companies and other relevant interested parties. Thus, close interaction will be achieved between academic and industrial partners.

8. RESEARCH WITHIN THE EUROPEAN COMMUNITY

The majority of Construction research activity, which is funded by the European Commission is conducted within the *Research and Development Programme on Industrial and Material Technologies (Brite/Euram).* All projects are a partnership between appropriate members to form a relevant team. Many European universities are partners in the Brite/Euram programmes. Currently the Commission supports twelve areas of Construction related research activity, which provide opportunities for universities to become involved. These areas are as follows:

- Environmentally Friendly Technologies for Construction Materials and Components
- Testing and Quality Assurance for Construction
- Construction Process and Management of the Different Life Stages of Construction
- Seismic and Vibration Isolation
- Improved Performance of Concrete in Structures
- Wood Properties and Technologies for Construction
- New Technologies in Geotechnical Engineering
- Steel Research
- Road Research
- Recycling in Construction
- Fire and
- Repair of Concrete Structures.

The aforementioned areas are not absolutely specific, but they do represent the current policy of the European Commission towards Construction Sector research. They present, therefore, opportunities for the involvement of European universities. Some explanation will be given of the scope of these areas to enable specific research topics to be identified.

Environmentally Friendly Technologies for Construction Materials and Components

Environmental matters remain high on the European Unions agenda. The Construction Industry has a key role to play in any agenda for sustainable development for the 21st century. For instance, buildings account for about half of all EU energy consumption and over a third of greenhouse gas emissions if account is taken of the energy intensity of manufacture and assembly as well as operation. Their environmental impacts at many levels can be recognized including the city and region, the estate and neighbourhood, the individual building, and in relation to the materials, components and systems of which the building is made. It is important to consider the full life cycle dimension. There are many environmental dimensions in relation to materials: the extraction, processing, manufacturing impacts; their energy intensity; the emissions associated with certain materials in service; and maintenance, demolition, recycling and disposal of construction products. There is renewed interest in 'cradle to grave' analysis of the manufacture, use, and disposal of building materials, although considerable difficulties

arise in undertaking such analysis and in obtaining adequate information on the constituents of materials and on fibre and gaseous releases.
Environmental labelling of new buildings, already in extensive use in a few countries, is attracting increasing international interest, while materials and technologies with reduced environmental impacts are emerging from research. These utilise innovative and radically modernized approaches to meet contemporary requirements.

Testing and Quality Assurance for Construction

It has already been stated within a vision for Construction that an important target for the Construction Sector is to improve the sustainability of the processes and products of the industry. This objective can be achieved by the implementation of a programme for testing and quality assurance for Construction. Activities might typically include: quality assurance of production, quality assurance of control of materials and components and monitoring of quality in structures. In principle, all stages of the Construction process and life cycle may be included in this research area. Typical projects in this area include the monitoring of large civil engineering structures for improved maintenance, improved quality assurance and methods of grouting post-tensioned tendons, improved production of advanced concrete structures, computer integrated road construction and automated air void analysis in hardened concrete. Clearly, there are many opportunities for university researchers to participate in this area.

Construction Process Management of the Different Life Stages of Construction

This area has a broad base and provides many research opportunities. Many types of material and construction techniques can be combined with construction concepts to address current and future problems. The future home for Europe is an important issue together with concurrent design and clean technology solutions for the life cycle of products. The development of new methodologies for the repair, retrofitting and refurbishment of buildings are relevant.

Seismic and Vibration Isolation

Although this area is mature, developments have concentrated on European issues for which solutions for specific problems are required. Technical discussions have been related to site dependant earthquake loading, structural damage, railway induced vibrations and vibration isolation. Specific research topics involve the development of advanced experimental facilities, the assessment of the vulnerability of structures, the development of isolation and dissipation devices and system identification for monitoring.

Improved Performance of Concrete Structures

This area addresses aspects related to improving the performance of concrete structures. Self-compacting, high strength and fibre reinforced concrete are typical examples of high performance concrete, which are being used to improve performance. The use of light-weight concrete and mineral additives is also known to improve performance. Other topics of current importance involve the establishment of safety factors for pre-cast concrete and the development of test standards for concrete. Environmental issues are relevant in this area, and these involve the consumption of energy and resources as well as the generation of waste.

Wood Properties and Technologies for Construction

Developments in this area are likely to move in the direction of the structural use of wood. Industry is currently developing a European-wide collaboration. Potential projects should combine the various starting points of the companies and markets in different countries. This would help to increase the utilization of the European renewable wood resource. A particular topic for research concerns the optimization of the wood conversion chain. A continuous information chain from the forest to the user would greatly improve the environmental friendliness of the use of wood in buildings.

New Technologies in Geotechnical Engineering

In recent years geotechnical engineering has evolved from being a discipline concerned largely with the design of earthworks, underground facilities and foundations to embrace geo-environmental aspects such as contaminated land, waste disposal and containment. The technologies required to address this broad field have also developed rapidly over the same period, and the use of new materials, sophisticated instrumentation and optimization of design during construction are becoming increasingly commonplace.

A number of themes are regarded as being of major importance for the future, including design issues, environmental issues, construction process issues, natural disasters and social issues. These themes will provide opportunities for universities.

Steel Research

The general theme of this area is associated with the application of steel in the urban habitat and, in particular, to find new applications for steel in the construction sector. Thus, the main objective is the design, validation and demonstration of steel intensive components and sub assemblies to be applied in urban habitats. Architectural design and industrial fabrication concepts should be coupled with the exploitation of the latest developments in both steel fabrication and building construction technologies. Three specific themes are considered important and these are: housing, refurbishment/overcladding and temporary architecture. Activities within these themes would include, low energy house construction, prototype overcladding systems and the construction of an office prototype with limited elements as a temporary facility.

Fire

High performance concretes have been developed extensively during the past few years. The behaviour of these concretes at high temperature has not been investigated adequately. Thus, the fire area of activity should concentrate on studying the behaviour of high performance and ultra high performance concretes in high temperature environments and to the development of specific software allowing the design of structures and the prediction of spalling in such environments. Considerable experimental work will be involved.

Repair of Concrete Structures

This is an important topic area and current considerations are aimed at producing guidelines for durability design and redesign. Important considerations concern the degradation processes of: corrosion of reinforcement due to carbonation, chloride induced corrosion and the effects of corrosion such as cracking and spalling of concrete.

For frost-thaw actions and alkali-silica reactions no sufficiently accurate models for the prediction of the degradation of a structure have been identified.

There are problems involving different deterioration mechanisms, which require investigation. Inspection, maintenance and repair are topics which provide considerable scope for research.

9. CONCLUSION

There are opportunities within Europe for universities to support the Construction Sector in both training and research and development. These activities are supported by the European Commission's programmes for the Sector. This paper has outlined ideas for enhanced training schemes. Also, the paper has been specific in the explanation of current thinking for areas of research and development and has suggested a broad base of activity for potential topics. There is no doubt that opportunities exist for European universities to support Construction.

ETHICS IN THE BUILT ENVIRONMENT (EIBE)

- A CHALLENGE FOR EUROPEAN UNIVERSITIES - A SOCRATES FUNDED INTENSIVE PROJECT OF 12 EUROPEAN UNIVERSITIES

Carsten Ahrens[1]

***ABSTRACT**: The SOCRATES Intensive Project „Ethics in the Built Environment - A Challenge for European Universities -“ shall bring together students and teaching staff of 12 European universities from south (Porto, PT, Valencia, ES, Patras, GR) to north (Tampere, FIN, Tallinn, EST) and from west (Galway, IRL, Groningen, NL) to east (Stettin, PL, Prag, CZ, Budapest, HU).*
The three years programme offers a forum to dicuss the different approaches to define „Ethics in the Built Environment“ from both the teaching and learning sides and in connection with professional bodies. Its aim is to provide a sound platform of common understanding about ethics in this context and to work out a common modul as part of the education of young civil engineers at the involved universities.

1. BACKGROUND

At least there are two backgrounds, the student‘s and the employed engineer’s view.

Students of the FH OOW who go to a foreign country and foreign students who come to Oldenburg now realize, that there are different sociological and cultural conditions in the host countries and different teaching and studying conditions at the partner universities. Meanwhile this is European students’ knowledge, which has been given to them by their predecessors.

But what students of civil and construction engineering are stating especially during their practical placements in a growing amount and with sharper contours is the other way of working and solving the problems of daily work on the construction site? It is not the technical aspect but the intercourse with partners and clients, the co-operation with colleagues and the public, the liability in contracting, the thrilling field between technical possibilities and demands of the environment which causes disbelief or even uncertainty.

Young future civil/construction engineers and managers are seeing themselves in a situation on which they cannot react in a proper way because of their up to now only technically oriented education.

But also experienced civil/construction engineers, supervisors of building sites and building or project managers are envisaging above their normal technical requirements numerous demands of different culture, working moral, ethical values, environmental responsibility etc.

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The mentioned forcing requirements will be overtaken individually depending on the personal status and behaviour. But in a uniting Europe with corresponding European-wide working possibilities it is necessary to do the job apart from pure individual solutions but on a strong basis of commonly respected measures of conduct.

2. THE STATUS QUO

The EU has opened the borders between the member states to all professionals, especially to civil/construction engineers. A civil engineer who wants to settle and to make up his own professional office in a foreign country has to undergo the national restrictions and professional requirements. And at least, he or she has to sign regulations of professional conduct as developed by the national professional institutions. In this *Intensive Project* it is this latter subject to deal with.

When working in the ECCE task force „Mutual *Recognition*" it turned out that this subject, „*Ethics in the Built Environment*" is understood in a very diverging manner, has many different facettes of regional, cultural, geographical, lingual aspects etc.

In the whole field of educating engineers in Europe there exists a very detailed description of equivalency of the engineers-status (see FEANI) and its education and training, but it concerns only the technical aspects.

Concerning civil engineering there is the European Council of Civil Engineers (ECCE) which states some few general requirements on the education and expertise profile of engineers in the built environment. But ECCE places aside a code of professional conduct the recognition of which is the basis for acceptance to be a member of a Register of European Engineers of the Built Environment and, thus, gives the supposition for a European-wide work permit.

3. GENERAL AIMS AND PURPOSES OF THE IP

The herewith described Intensive Project EiBE does not deal with the technical aspects of engineering education. But it comes up with the idea of ECCE in that way that the participating partner institutions shall form a catalogue of code of conducts according to a given frame at home which shall be summarized during the IP-meeting into a common catalogue.

The idea behind this project, too, is that young engineers and/or students shall discuss this topic on a stage before employment and, thus, before being too much engaged in companies' and employers' strategies and - sometimes - restrictions. To get a better European aspect this project brings together about 50 students and lecturers from about 12 different European partner universities, their respective civil engineering departments and some members of engineering societies.

It is obvious that the students will also have different ideas about ethical rules in their future job, that there are different understandings of words and their content, like the "old" ECCE members found it out. And it is necessary to gain the variety of understanding to put it in common understanding.

The common catalogue which has to be created will be used as the basis of a common module "Ethics in the Built Environment". The module will be roughly formed or shaped during the first IP-meeting which takes place at FH OOW in Oldenburg from 20. till 30. September 2001.

In the second and third project year this module has to be revised by the partner institutions in co-operation with national institutions of engineers and the building industry to finally produce a module together with ECCE which will be offered to all partner institutions with civil engineering departments as part of the obligatory teaching programme – and hopefully to other EU institutions of higher education.

4. CONTENT

Using the ECCE paper and adding as the first point the German VDI terminology, the discussion platform for ethical rules in the Built Environment should involve the following points:

1. Definition of terms
2. Behaviour of the engineer in the public
3. Behaviour of the engineer facing the environment
4. Behaviour inside the employment
5. Behaviour of the engineer facing clients and employer
6. Behaviour of the engineer to colleagues
7. Development of ethical rules

The IP includes 10 working days; 2x20 contact hours are assigned and 10 further hours are assigned for working in groups; this amounts to a number of 50 working hours. Taking into account also cultural arrangements and intercultural events the IP would come up to about 2 ECTS credit points. The participants are given a certificate for successful completion of the project. Some of the participating institutions are granting this paper as an equivalent of the mentioned 2 credit points.

All participants have prepared a paper on one of the subnumbers of the above mentioned ECCE code of professional conduct. This code has been sent to them or to their lecturer in March this year. The students have been invited to participate in the project but had to work out a paper of about 6 DIN-A4 pages. This paper has been judged by the respective colleague and has been sent to me via e-mail or by letter. The best of them (2 up to 4 students) will participate in the project in Oldenburg.

To gain a better continuity in the project we tried to involve students of the first (undergraduate) study years so that they can work also in the following project year(s). In addition we tried to have an equivalent European composition; but as it happens always there are more or less students and more or less active cooperation partners and students.

The table 1 gives a rough overview of three years work and its proposed results.

Table 1 Overview of the three years work results

Year	Programme
1. Project year 2000/2001	Creating a list of ethical rules 1st version of the module Coordination with national Engineering Associations
2. Project year 2001/2002	Evaluation and revision of rules and module 2nd version of the module Coordination with national Engineering Associations
3. Project year 2002/2003	Production of the final version of the “Ethic-module”to be used in the course work - in the project countries - in the EU (as a module with example character)

At the first meeting the papers will be presented and discussed in the plenum. In working groups specific thematic points will be worked out and presented twice during the project period. We will have the usual paper presentation, a discussion forum with members of groups and societies of the Built Environment and we try to use video presentation of case studies and visualized role plays. The developed material for the IP will consist of a 30-page booklet at least in the working languages English and German. It includes thesis, working sheets, question and answer lists, video recordings and role playings.

In the second year the material will be revised in the respective partner institutions in cooperation with national engineering associations and/or building companies. The collection has to be finished before the second meeting and based on these papers a detailed working plan for the second meeting will be prepared.

The second meeting will be organised at Prague Technical University and the final meeting possibly at the University of Porto (where the president of ECCE is lecturing as a professor in the civil engineering department).

5. CO-OPERATION PARTNERS

The following institutions of higher education are involved in this programme:

Name	Abbre-viation	Country	Tasks and responsibilities
Fachhochschule	FH OOW	DE	Co-ordinator, organisation, science
Oldenburg/	FH OOW	DE	internat. office, organisation, pedagogic care
Ostfriesland/	FH OOW	DE	Translation care
Wilhelmshaven	FH OOW	DE	Communication, examples
“	FH OOW	DE	Video-recording
“	FH OOW	DE	Homepage
Hanzehogeschool Groningen	HvG	NL	University co-ordinator and TN
University of Wolverhampton	UoW	UK	University co-ordinator and TN
Galway Mayo Inst. Techn.	RTCG	IR	University co-ordinator and TN
Hogeschool Halmstad	HH	SE	University co-ordinator and TN
Tampere Technical Inst.	TT	FI	University co-ordinator and TN
Techn. University of Stettin	TUoS	PL	University co-ordinator and TN
Czech Techn. University Prag	CVUT	CZ	University co-ordinator and TN
Techn. Coll. of Eng. Tallinn	TCET	EE	University co-ordinator and TN
Kaunas Techn. University	KTU	LIT	University co-ordinator and TN
Gödöllö Univ. Ybl Miklos, Budapest	YMMF	HU	University co-ordinator and TN
Ecoles Sup. Traveaux Public, Cachan	ESCIT	FR	University co-ordinator and TN
TEI Patras	TEIPat	GR	University co-ordinator and TN
University of Valencia	UPV	ES	University co-ordinator and TN
University of Porto	UoP	PT	University co-ordinator and TN

Table 2 Participating universities and their tasks

Each of the universities taking part works closely together with the building industry, building associations, building authorities and chambers of engineers, which will be involved in the second and third project year as partners. In the first project year members of these institutions will be involved in personal consultings, but not yet the institution itself.

6. RELATIONSHIP BETWEEN INTENSIVE PROJECT AND EXISTING COURSES

At all partner-universities which are involved in this project, civil engineers, building and project managers (at national and international courses) and building economy engineers are educated as full-time- or part-time-students. The problem that you find other social values and working conditions and social-economic and ethic working attitude at foreign places of employment, applies to all of the students in the Built Environment from all the partner universities.

All of the partner universities see the necessity of a corresponding preparation and education of "other" values and want to prepare and use such modules in the optional sector, but some also in the compulsory sector during the study.

7. ACTIVITY AND METHODOLOGY AS WELL AS PEDAGOGIC AND DIDACTIC ASPECTS

The participating lecturers are responsible for the local co-ordination and they should speak to students of their courses and make them interested in the project. The interest in the project should be intensified by the possibility for the students with the most extensive, very original and initiative or otherwise excellent results to take part in the common making conscious work at the beginning of the winter-term 2001.

The pedagogic aspect of the preparing section consists of the importance of ethical questions in the later employment of the students. Students will ask civil engineers and building managers for their opinions, the results will be prepared as homework and students will report on them. The preparation will be completed by a common result of the group at the partner university, which should be made in the home language and in English or German.

Further informations: http://www.fh-wilhelmshaven.de/oow/aka/socra/

A STRATEGIC MODEL TO CHANGE THE SOCIAL IMAGE OF THE CONSTRUCTION INDUSTRY

Emília Maria Delgado Domingos Antunes Malcata Rebelo[1]

ABSTRACT: *In this article it is proposed an innovative marketing model developed in order to deal with the nasty image people have during the construction process of any urban development. It is based upon strategic planning and management paradigms, involving a situation analysis, a resource and competency analysis, the clear definition of mission and objectives of the urban plans and projects, and the establishment, through the use of the marketing rationale and tools, of a strategy and such ways of its practical implementation that generate the citizens´ involvement and collaboration. This knowledge of the interconnections of the urban plans and projects, their consequences to citizens´ everyday life, and the democratic participation of citizens will assure the success of implementation of city development that stands upon the promotion of the quality of life.*

1. INTRODUCTION

The construction process consists in the ways of implementation of plans and projects that represent some bigger or shorter change in the status quo of everyday city life. This poses an inter-related set of problems, beginning from the insecurity derived from lack of knowledge of the plans and projects, passing through the insecurity feeling of the construction process itself, that generates big changes in people daily practices and lives.

The city exists not by itself, but as a general interactive framework where everyone lives its social, personal, and professional life. So, there exists a social and psychological valuation of urban life that is inter-connected with many representational social strategies and practices whose articulation occurs at the urban space. Besides the representation of the dominant spaces in a society (showed through planned and rational urban locations, and through the architecture of certain projects), there are the representational spaces (spaces thought and lived by users´ daily routines), and the special practises (that give form to the social spaces, and run from daily displacements to sophisticated communications through global networks (Lefebvre, 1974; Allen & Pricke, 1994). Even the local productive systems, that bear on the dynamic articulation of social and cultural specific agents, with different ways of work and reference frames that co-survive in urban life, have the potential to be a factor of economic valuation of space (Negri, 1995, Marotel, 1995), Di Benedetto, 1995).

In this framework, so, it is significant that the planning and the management processes of development are clearly understood and assimilated by citizens. Development consists in welfare generation, as well as its redistribution, based upon the principles of justice, equality of opportunities to everyone, environmental sustainability,

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resource continuity, and overall democratic access to information. The development process supposes the respect and valorisation of individual´ willing.

At the same time, the planning process consists in a rationalization effort: on the one side, in the physical sense of allocation of the appropriate locations to the different activities, on the other side in the economical sense, because it is aimed to assure welfare distribution through the state intervention. Planning is, consequently, a support tool to development: it looks forward to anticipate citizens' needs and aspirations, organizing means to give them an appropriate answer, and generating new dynamic processes. The development process is essentially a social concept and, as so, it should be centred in people and social groups. Even the articulation of policies at different levels and subjects is deeply dependent on the relationships the agents of decision are able to establish to local residents.

The urban systems are increasingly complex and dynamic, and the ways to govern tend to become strongly dependent upon the interaction between the local authorities and the society (Oliveira, 2000). Nowadays, urban policies should deserve three kinds of concerns: they should be market-friendly, people-friendly and environmental-friendly (Picciotto, 1997). The definition and implementation of successful urban policies needs to conciliate points of view among the different urban agents, and are strongly dependent upon their interactions.

There are significant urban resources necessary to correct social exclusion of certain groups, to assure employment in urban areas, as well as to bet in the environmental quality, that deserve important economic, physical and social investments, which cannot be entirely satisfied by the market (European Commission, 1999).

At the European level, we have been assisting to a turning point in the relationship between the state and the market, in sectors with a strong urban dimension, particularly in what concerns lodgement, social services, education, transports and communications, and even energy and water delivery, as well as the elimination of solid wastes. On the other side, there have been an increasing number of services assured by joint-ventures between public and private firms, what secures the capital, technical and personnel support to the development process.

The management of cities must become more creative and must show great imagination in designing financial as well as marketing solutions that not only support economic, social and environmental subjects but also generate overall psychological acceptance by the citizens. Thus, a cultural turning point is needed, in the sense of the establishment of new forms of work and communication among the public and private sectors and the local communities. This is particularly important in the regions underdeveloped, where the pressures to modernity and actualisation impose big pressures on local budgets (European Commission, 1999).

An urban successful environment requires not only the articulation among the different agents already referred to, but also the establishment of a functional diversity (Wang, 1996), betting upon the new technologies, marketing and financial engineering tools, which, if well managed, promise to become competitive advantages.

Actually a great number of cities make use of the urban marketing to promote their images and not only attract new developments and investments, but also to generate competitiveness (Newman, 1996; Fincher, 1981). The real estate marketing is able to create symbolic representations of real estate complexes, with architectural, environment and individual equipments targeted to specific population and professional levels, that strongly reinforce urban feelings of personal and social involvement (Kratke, 1992). However special care must be devoted to these tools (Bailey, 1993) because a good marketing management must essentially be based upon the identification of the local and city needs, and the development of ways to generate people overall acceptance, involvement and participation.

2. PRESENTATION, DEVELOPMENT AND APPLICATION OF THE MARKETING MODEL

The marketing concept applied to the urban level centres on all the activities of the urban management targeted to satisfy the citizens´ needs, through the integration of these activities with marketing, assuring long-term urban goals are met.

The implementation of this concept goes through the following steps:

- The identification of the citizens´ needs;
- The establishment of the market development offer;
- The coordination of financial, technical and personnel resources;
- The assurance of the citizens´ satisfaction;
- The attainment of the city objectives.

In the establishment process of a marketing plan to a city, special care must be devoted to the following issues (Guiltinan & Paul, 1988):

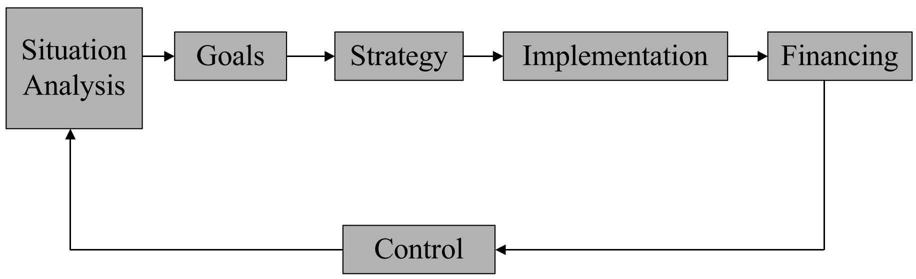

Figure 1 The strategic Planning and Management Process

1.The conduction of a situation analysis

Before any action plan is developed, decision makers need to understand the current situation and trends affecting the future of the city. In particular, they must access the problems and opportunities posed by costs, regulatory changes, consumption needs of products and services, and the public and private urban agents strategies and actions. Additionally, they must identify the strengths and weaknesses possessed by the urban management and agents.

2. The establishment of objectives

Once completed the situation analysis, the decision makers must then establish specific objectives. Objectives identify the level of performance the city management hopes to achieve at some future date, given the realities of the environmental problems and the opportunities, as well as the city specific strengths and weaknesses.

3. The development of strategies and programs
In order to achieve the stated objectives, decision makers must develop both strategies (long-term actions to achieve the objectives) and programs (specific short-term actions to implement strategies)

4. The establishment of coordination and control
Plans that are fairly comprehensive often include multiple strategies and programs, and each strategy and program may be the responsibility of a different manager. Thus, there must be developed mechanisms to assure that the strategies and programs are implemented in effective ways. Organizational structures and budgets are the primary means for coordinating actions. But the control process is also essential because the success of strategies and programs can never be predicted with a hundred per cent certainty. The control purpose is to evaluate the degree to which progress toward an objective is being made and to point out the causes of any failure to achieve objectives, so that remedial actions can be taken.
The case study application of this urban marketing concept and its implementation to the urban project “Oporto 2001 – European Capital of Culture” begins by a situation analysis of the Oporto city, which includes the identification of the strengths, weaknesses, opportunities and threats at the urban level.

The *weaknesses* identified are the following:
- The abandonment of habitation settlements, together with the increasing degradation of urban life conditions
- The demographic declining
- The increasing desertification and corresponding criminality development
- Difficult accessibility to the city centre
- Vehicle parking problems

The *strenghs* consist of:
- A great social population cohesion
- Oporto historical centre is an Humanity Patrimony, recognised by UNESCO

The *opportunities* consubstantiate in:
- The Oporto is the centre and the head of the Metropolitan Oporto Area in political, historical and cultural terms
- The urban local economy is extremely important and diversified
- The urban architecture has a great symbolic and patrimonial value

The *threats* (that, however can become opportunities if Oporto clearly assumes itself territorially, socially and economically as a long-sighted city with a metropolitan area) consist of:
- The increasing attractiveness of Oporto peripheries, not only in spatial terms but also in what concerns land prices
- The development of the new telecommunications and informational technologies, that narrows the concept of centre (Stiegler, 1995)

- The ascending public conscience of urban basic rights (the right to a high quality environment and to a balanced urban life quality)

The mission of the project Oporto 2001 is to promote tourism, culture, and the requalification of the Oporto city, in such ways that guarantee local needs, and respect the sentiments, traditions and dreams of population.

The more specific objectives upon which the mission is built are:

- To generate the citizens´ contribution to the development process, asking them what their needs are, and taking advantage of their professional experience as well as city life, habits and social life in aiding to implement the development process
- To generalize the overall information about urban projects to the whole population, through publicity, exhibitions, conferences and other cultural events, showing people the practical impact of the transformations proposed to their everyday life. This process of information should be made significantly before the beginning of the construction or reconstruction processes, in order to avoid psychological rejection of them.
- To develop citizens´ conscience that the construction process is a necessary part to the future improvement of the quality of life, as well as the feeling of citizenship, and the basic principles of security, not only at the school level but also at the different communities´ associations level.
- To develop marketing campaigns, where the heads are important people to the city individuality in cultural, political and sport fields, and to cover the repairs during the construction process with great panels that show the expected finished project.
- To respect the materials, architecture and history of the urban spaces of the actual city where people live and develop their work, studies, and social activities

The development of strategies and programs in order to achieve the settled objectives, and their implementation, must be supported in the penetration and development of the basic concept of the Oporto 2001 event, through the establishment of multiple relations of the project to the everyday life of the citizens.

The strategies and programs must bear in mind the strategic interconnection among the different fields in the city life, and the core role that the marketing concept can represent as an overall unifying of the urban positive feeling (Figure 2).

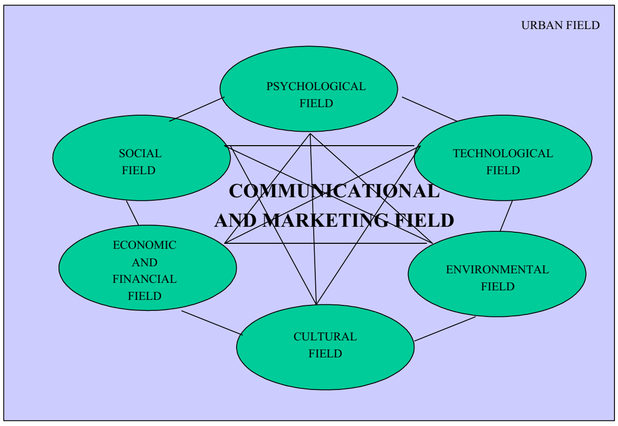

Figure 2 Interconnection among the different fields in Strategy and Programs definition and implementation

In what specifically concerns the implementation processes, this model proposes that a comparison be made between the Maslow pyramid of the necessities, and an original model that corresponds to this pyramidal construction in a social perspective.

In the Maslow model a necessity constitutes a dominant motivation. Once the basic necessities are satisfied, another necessity that locates at a higher level in the necessity pyramid becomes the motivator (Figure 3).

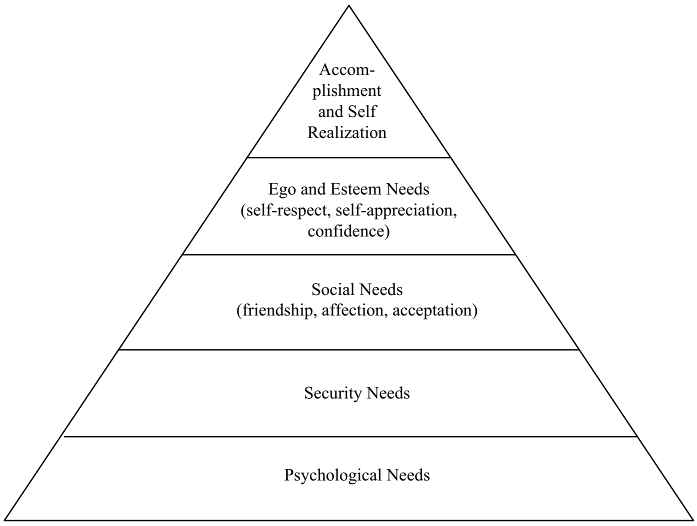

Figure 3 Maslow necessity pyramid

In the proposed implementation model for the construction industry the actions at the different fields are interconnected in a network that is showed trough a representational matrix (Figure 4).

As can be seen, the “construction process” of this marketing project tries to satisfy all the basic social needs, but a market segmentation is increasingly needed in order to adjust the urban general project(s) to the specific needs of groups, and, in extreme, to people individual needs, dreams and expectations.

Finally, the coordination and control process should be based upon the construction of an observatory of some variables that should be closely monitored, such as:

- The definition of an index of satisfaction based on enquiries to the some community representative individuals in some selected zones and communities;
- Monitoring of the construction processes, assuring all the security rules are respected;
- Measurement of the number of cultural events, exhibitions and conferences at the different city zones;
- Marketing processes of making random enquiries in order to assure the message of the urban project is correctly understood by citizens.

In what concerns the budget for the urban project, besides the financing of the global marketing project, a part of it should be devoted to the education of the construction workers and another part to the establishment and control of the security conditions during the construction process itself.

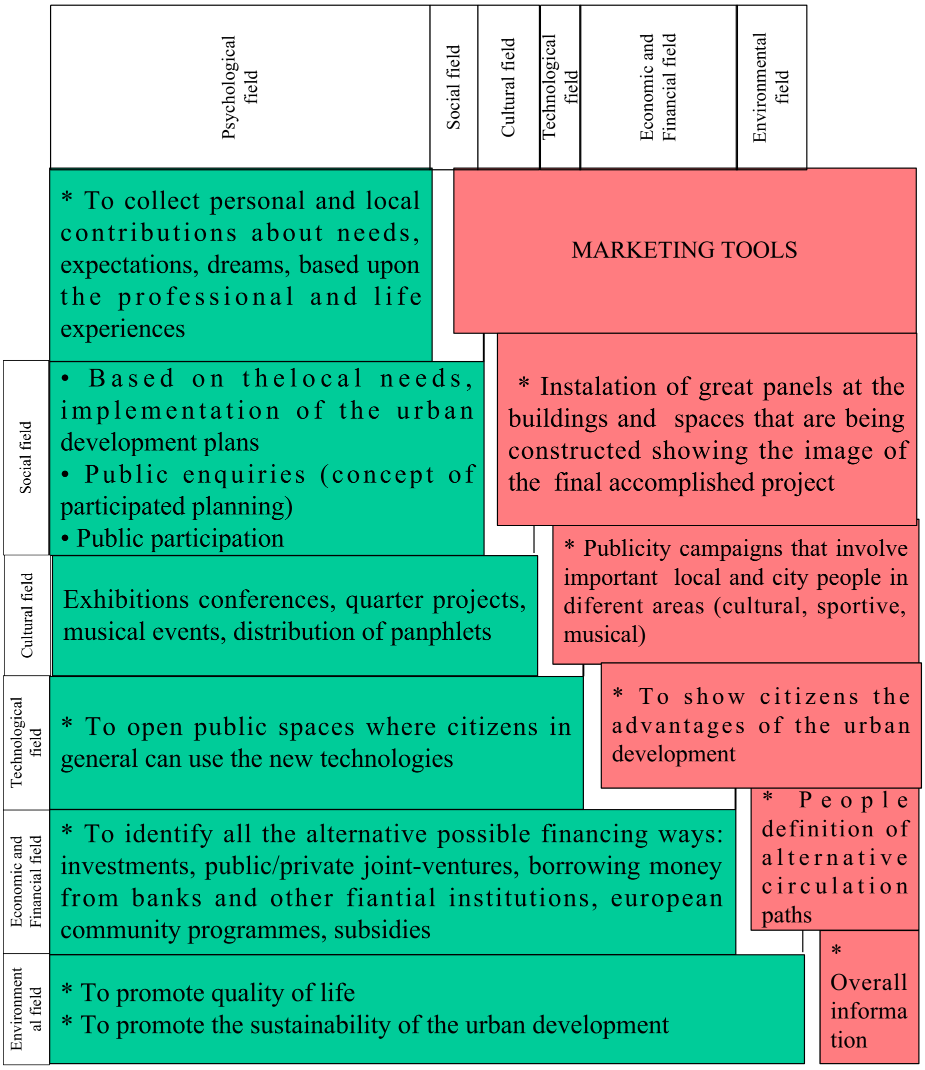

Figure 4 Proposed Analysis Matrix of the Marketing Strategy and Implementation Model

3. RECOMMENDATIONS AND CONCLUSIONS

In this article it is pointed out the importance of the construction processes as ways to assure and implement urban development. It is proposed a global marketing plan. The development process of the city should be understood as a whole, and people should be deeply informed about the characteristics of the projects, and the advantages that they are going to represent to everyday life. This information process must be done in advance and in segmented ways according to the features and styles of life of the different citizens. Besides, this should be complemented with a more long-term oriented educational process, as well as to the understanding that social projects become successful when they are able to generate the involvement and collaboration of the citizens.

This model, that leads to the change of the psychological and social image of the construction industry, has the potential to be applied in many other construction realities in any part of the world, guaranteeing overall psychological acceptance and social participation of all citizens.

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THE ROLE OF HIGHER CIVIL ENGINEERING SCHOOLS IN TRAINING COMPETITIVE ENGINEERS

Ivan Pavlov[1]

ABSTRACT*: It is an accepted fact that Europe has entered a period of general integration which includes higher civil engineering education, presumably under the motto "A mobile, polyvalent civil engineer". In order to create such engineers it appears necessary to set up a real professional community in Europe, which should be widely open and create traditions, keeping abreast of all new trends in modern civil engineering thought. Aiming at defining the role of universities in modern training of civil engineers, the paper discusses issues considered of paramount importance, such as: structure of syllabuses and need for their annual renewal; need for regular professional contacts between universities and construction industry; necessary balance between theoretical knowledge and practical skills acquired during the training process.*

1. INTRODUCTION

In order to specify the role of higher civil engineering schools for training civil engineers, it is necessary to discuss the following issues:
- structure of syllabuses and the need for their annual renewal;
- influence of students and the construction practice on the syllabuses;
- need for regular professional contacts between higher schools and construction companies;
- necessary balance between theoretical knowledge and practical skills acquired during the training process.

It should be born in mind that the young generation of civil engineers, regardless of the country they have been trained in, are well oriented within the requirements for mobility and competitiveness.

Modern civil engineers cannot have any claims to be prestigious specialists unless they are polyvalent, mobile and competitive.

We are now living through a period of general European integration which includes higher civil engineering education, presumably under the motto "*A mobile, polyvalent civil engineer*". This kind of engineer is also expected to be competitive.

2. REQUIREMENTS OF ENGINEERING EDUCATION PROVIDED BY HIGHER SCHOOLS

What should the higher schools provide for the future civil engineer?

A number of distance learning courses are now underway but nothing can replace the personal contact between lecturer and student. Due to this contact, schools

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of outstanding lecturers-creators, building up the history of the construction genius, have been and will be created.

The knowledge related to the fundamental sciences is reinforced and enriched. This knowledge enables the young specialists to later take up the specialised disciplines leading them to the construction practice, on the one hand, and to the research work in case they feel attracted to it, on the other.

The so-called "*intermediate disciplines*", such as environmental protection, ecology and ergonomics, have nowadays acquired special significance. The operating strict European standards in these fields require that civil engineers be competent enough in their application. Here it is possible to give many more examples illustrating the management and organisation of the construction business.

As far as the specialised disciplines are concerned, students should be offered the opportunity to choose among differently oriented modules. This will make them believe firmly that they acquire knowledge corresponding to their individual wishes and aptitudes and that they will be able to devote themselves completely to their vocation.

3. THEORETICAL KNOWLEDGE VS. PRACTICAL SKILLS

A crucial and debatable issue is the balance between the theoretical knowledge and the practical skills which the higher school is supposed to provide for the students.

The civil engineering profession involves a strong relationship between theory and practice. For instance it is not possible to acquire theoretical knowledge without rich exemplification of how that knowledge can be used on the "*construction site*". Nevertheless, it should be remembered that the training process is limited in time and that the higher school trains engineers and not construction technicians.

In summary, a civil engineer can quickly learn how to figuratively "*mix concrete*" whereas a master-concretor will not be able to dimension a reinforced concrete structure unless he has received serious additional training.

Young civil engineers, trained as specialists to a certain level at the higher school are offered the opportunity to do a wide variety of activities such as designing, participating directly in the implementation of a given construction project, exercising control, being involved in the management and administration of the construction business or doing research work. Whilst all those activities require high engineering qualification, the level of practical skills needed to perform each one is different. Therefore it is only natural that the respective specialist should continue his/her qualification and acquire easily any lacking knowledge or skills.

4. MOBILITY AND POLYVALENCE OF YOUNG EUROPEAN CIVIL ENGINEERS

The young generation of civil engineers, regardless of the country they have been trained in, are better oriented within the requirements for mobility and somehow manage, if they wish, to continue their professional qualification in accordance with their specific interests. In general, modern engineers cannot claim to be prestigious specialists unless they are polyvalent.

The concept "*polyvalent*" here means having high competence to perform a set of professional activities related to the construction business. In this sense, a polyvalent engineer who speaks foreign languages can be mobile and competitive in all European countries.

In order to create mobile, polyvalent European civil engineers, it is necessary to set up a real professional community in Europe, which should be widely open and create traditions and which, at the same time, should keep abreast of all new trends in modern civil engineering thought. This community should attract students, make them self -confident creators and not technical performers, and inspire the realization of their creative abilities in the engineering profession.

Thus, a civil engineer who is well-informed and highly accomplished and who can communicate in several languages, will be capable of creating valuable engineering products in terms of social, economic and environmental compatibility and will consequently become a competitive and self-assured person.

5. CONCLUDING REMARKS

What are the possible ways for the European higher civil engineering schools to participate in building up the aforementioned community whose support skeleton is already existent? The short answer to this question are numerous *contacts* in all sectors of the construction industry and in all possible forms. These contacts will finally result in clarifying and harmonising the basic tendencies in the respective higher civil engineering education.

In conclusion, it is necessary to note that if the countries of Europe are willing to produce their civil engineers-creators, they should never forget the decisive role of the higher schools for their training. The state institutions and the private sector concerned should provide financial and spiritual support to these schools so that they can fulfill their mission successfully.

SYNERGIES BETWEEN UNIVERSITY, PUBLIC AUTHORITIES AND INDUSTRY IN CIVIL AND ENVIRONMENTAL ENGINEERING IN FINLAND

Matti Lojander[1]

***ABSTRACT**: In Finland Civil Engineering is taught in two universities: Helsinki University of Technology (HUT) in Otaniemi and Tampere University of Technology. Both universities have good co-operation with Finnish public authorities and companies.*

The financing of the Helsinki University of Technology is based on the Finnish state budget and on the acquired funding. In the near future the acquired funding is supposed to be bigger than the state budget funding. The whole income is more than 1 billion Finnish marks (165M euro). The most important fund (35% of the acquired funding) for the university is TEKES, the National Technology Agency. Also Finnish Academy (14%) and foreign fundings (6%) are important. More important is anyway the funding of domestic industry and other national financing (39%). Most of the TEKES-projects are carried out together with Finnish industry and therefore the contacts between the university and companies are very good.

The financing of the Department of Civil and Environmental Engineering is quite similar to the financing of the whole university. In the year 2000 the department used 53 Million Finnish marks (9M euro). The acquired funding consists of: TEKES, the National Technology Agency 33,9%, Finnish Academy 11,4%, domestic industry 19,8%, public authorities 23,8%, foreign financing (incl. EU 1,5%) 4,5% and others 6,6%.

The money allocated from the state budget is mostly used for the personnel expences and for real estate. All the other money used for research and teaching expences, equipment and fittings is covered with externally acquired funding.

The article deals with the co-operation between the laboratory of Soil Mechanics and the Foundation Engineering and Finnish industry and public authorities. The co-operation is very active in teaching and in research works. The diminishing state funding, and at the same time, the flexible possibilities for the acquired financing is a real challenge for the University.

1. INTRODUCTION

Helsinki University of Technology (HUT) consists of 12 departments and some Research and Separate Institutes /http://www.hut.fi/. The departments are:

- Automation and Systems Technology
- Engineering Physics and Mathematics
- Computer Science and Engineering
- Industrial Engineering and Management
- Electrical and Communications Engineering
- Mechanical Engineering

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- Chemical Technology
- Materials Science and Rock engineering
- Forest Products Technology
- Architecture
- Surveying
- Civil and Environmental Engineering

The whole amount of the students is 13 381 (11 235 undergraduates). In the year 2000 the total number of degrees was 1051: 869 Master's degree, 92 Licentiate Degree, 90 Doctor's Degree. In the University are working 231 Professors. /HUT REPORT 2000/.

The Department of Civil and Environmental Engineering consists of 12 chairs:

- Bridge Engineering
- Structural Engineering and Building Physics
- Foundation Engineering and Soil Mechanics
- Structural Mechanics
- Construction Economics and Management
- Building Materials Technology
- Steel Structures
- Highway Engineering
- Water Resources Engineering
- Transportation Engineering
- Environmental and Sanitary Engineering
- Environmental Protection

The amount of Professor is 19. Most of the laboratories consists of 1…2 Professors, 1 Laboratory Manager, 1…2 Assistants or Senior Assistants, 1 Secretary, 1…2 Laboratory Technicians and several Research Students and Engineers.

The Laboratory of Soil Mechanics and Foundation engineering consists of 2 Professors (+ 2 active Emeritus Professors), 1 Laboratory manager, 1 Senior Assistant, 1 Secretary and 2 Laboratory Technicians. According to the externally acquired financing, several Research Engineers and Laboratory Technicians and students are also working in the laboratory (Year 2001: 6 Research Engineers and 1 Technician).

The Money allocated from the state budget (2,0MFIM) is used for the personnel expenses and for real estate. The externally acquired funding (1,8MFIM) is mostly used for the salaries of the Research Engineers.

2. THE ACTIVITIES AND FUNDING OF THE DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

In the Department of Civil and Environmental Engineering are studying 942 students (707 undergraduates). In the year 2000 the total number of degrees was 75: 62 Master's degree, 7 Licentiate Degree, 6 Doctor's Degree. The amount of new Civil Engineers in Finland is too small and that is why most of the students are working during semesters in consulting companies, in the laboratories of the University or Technical Research Centre etc. That means that the mean time for examination is almost 8 years (5 years programme). Especially the doctoral students are not very active because only 13 of 250 are getting the Licentiate or Doctor's degree.

In the year 2000 the Department of Civil and Environmental Engineering got 26MMk from the state budget. Almost same amount (26MMk) was collected outside.

The most important sources for fundings are TEKES, the National Technology Agency, Public Authorities, Finnish Industry and Finnish Academy. Foreign funding is still less than 5% but it is all the time increasing.

3. THE ACTIVITIES AND FUNDING OF THE LABORATORY OF SOIL MECHANICS AND FOUNDATION ENGINEERING

The laboratory of Soil Mechanics and Foundation Engineering is a typical unit in the Department of Civil and Environmental Engineering. The main tasks are teaching and research work. Because of the small group of students the activities are concentrated mostly for research purposes. Very often the research projects are so short and small that they do not offer possibilities for reaching the postgraduate degrees. Anyway most of the small projects are scientific and they give good information and data for teaching and long duration research work. Most important projects are funded by TEKES, Finnish Academy, EU, and Public Authorities. They are continuing several years.

The most important activities and projects in 1990's and 2000's in the Laboratory of Soil Mechanics and Foundation Engineering have been:

- Georeinforcements (Funded by TEKES, Cities, Finnish Road Authorities, Consulting companies and Material suppliers)
- Soft Clay Modelling (Finnish Academy)
- Continuing education courses (Finnish Road Administration, companies, cities, Finnish Railways etc)
- Deep Stabilization (TEKES, Cities, Finnish Road Authorities, Consulting companies and Material suppliers)
- Road Structures Research Programme (Finnish Road Adminstration and Technical Research Centre (VTT))
- Soft Clay Modelling for Engineering Practice (SCMEP), (European Union)
- Laboratory testing for research work and for practical geotechnical design (Finnish Road Authorities, cities, consulting companies, Finnish Railways…)
- Competition to Calculate the Settlements of Haarajoki Test Embankment (Finnish Road Authorities)
- Frost Research.

The laboratory of Soil Mechanics and Foundation Engineering founded 1989 so called "Host Group" for organizing continuing education courses. The Host Group consists of the leading geotechnical engineers of some consulting companies (VIATEK LTD, SITO LTD), The Finnish Road Authorities, VTT, the City of Helsinki. The members of the group have been active for helping the laboratory in the Finnish Academy projects and in the EU-project (SCMEP). Especially the role of the Finnish Road Authorities has been very active for finding good test sites and research projects for the laboratory.

The TEKES-projects are always funded also by Finnish industry and companies and public authorities. Typically they cover 50% of the total financing. And in all these project there are a supervising group of 4...5 specialists. These groups are very active because they are also responsible of the results of the projects.

4. SUMMARY

Helsinki University of Technology is the oldest and the biggest technical university ion Finland. The situation in Otaniemi Science Park in Espoo, next to Helsinki gives good possibilities for co-operation between the most important organizations in technology.

The competition for getting fundings with other research institutes (Universities, VTT, Polytechnics Etc.) is hard. In the worst case the professors are using their time for acquiring the money instead of research work. That is why it is important that the university stuff is also active socially and politically for certify that those who are making decisions remember also the great importance for financing long duration research.

THE ROLE OF LABOUR MARKET AND EXTERNAL CO-OPERATION

Jan Bujnak[1]

ABSTRACT: *The main objective of this paper is to summarise, complete and discuss potential improvements of education process through external faculty co-operation and external academics as well as reviewers involvement in university activities. Possible difficulties as well as existing constraints, which could be met in implementation of these measures are also illustrated.*

1. FACULTY AND ENVIRONMENT

Faculties should develop close relations with the society, industry and public administration and cultural institutions, to disseminate knowledge and respond to their needs, and also to seek financial support for activities of common interest. Faculties also have a role in promoting the competitiveness of the national industry, educating qualified students and engaging in research activities at international level. Students and staff members should thus be encouraged to take part in international exchange programmes and international research co-operation. In addition to serving students, the universities should develop educational programmes for foreign students.

Given the mandate of universities, it is important to develop close contacts with the external environment in order to receive feedback on the key problems of the society in our time as perceived by the industry, public authorities and other users of university research and educational activities. Personal contacts of staff members and faculty representatives may be the best guide when directing the efforts in education, training and research.

Links between universities and industry are complex and include a wide range of forms of co-operation. Student recruitment, training, research and consulting activities are traditional reasons for the partnership. Relationships with university departments are often associated with existing consulting and research links.

Universities have a particular responsibility for basic research and research training. Teaching and research are to carry equal weight in the university system. The faculties are, furthermore, responsible for disseminating knowledge of their activities. The salary for the academic staff presents the most important funding for the independent and basic research activities. Research programmes directed towards priority areas are founded by research grants as the additional external sources.

Applied research activities in co-operation with the industry are one way of disseminating research findings. Other measures could be applied to enhancing research quality. Staff members at some universities may be granted a one year leave of absence and free use of equipment and laboratories to develop promising research topics, and to obtain the intellectual property right of products resulting from such research and development activities.

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Universities receive a budget for equipment from the Ministry. However, the universities also need to upgrade their equipment and library services. The industry should also be an important financial partner for advanced scientific equipment.

External contact is necessary to ensure the relevance of university activities. However, the search for external means to finance research activities also entails a risk that too much attention is given to serving the present and near future needs of the industry rather than any long term needs. On the other hand, external contributions enable the university to pursue activities which would otherwise not have been possible. Co-operation with the industry and public agencies might cover outside research activities, the financing of doctoral students as well as continuing education courses. Traditionally, industry takes less interest in co-operating with other university activities. It should be mentioned that universities are also cultural institutions, not only institutions of higher education. Universities should establish co-operation with the municipalities and other cultural institutions.

International co-operation should be encouraged for the benefit of university students as well as researchers. Universities may also be valuable partners to national industries in their internationalisation efforts. Thus, measures should be taken to support internationalisation. Universities should offer sabbaticals leaves for staff members who wish to work abroad as part of their academic careers. Students and staff members may also obtain scholarships to cover their travel costs when studying or working abroad. An active participation in the EU programmes opens other possibilities.

Universities should place great importance on developing strong links with universities and research institutions abroad. Individual staff members participating in various international networks and programmes may also develop extensive international contacts.

Today, part-time studies have become the classic form of qualification provision. Attending the university to gain a higher education qualification, part-time students should cover the same material as full-time students. The potential importance of part-time studies has re-emerged in recent times with a tendency towards mass higher education and continuous re-training of those employed in order to maintain their competitiveness in the labour market.

Employees have multiple reasons for studying on a part-time basis: to do their own jobs better, to prepare for promotion, or to get a better job. Sometimes their learning does not immediately relate to their current job.

Accreditation of prior experimental learning and the following work-based learning have attracted a greater interest in recent years since they allow people to gain credit for learning, which occurs in the course of their work. Such learning has become equivalent to learning in an academic institution. This type of studies could in our country also emphasize the partnerships between the employers and educational institutions. As the university has become more dependent on industry sponsorships, industry has started to require a higher education provision that meets its needs. However, the university needs to maintain the broader view of knowledge, beyond what is immediately relevant to a particular job. The students should receive an education which not only equips them for the current situation, but also prepares them for the future.

The recruitment of qualified academic personnel is, in general, unsatisfactory in our country. In several areas, the universities compete directly with the industry or other institutions on the recruitment of personnel. In some disciplines, academic candidates are not even available in our country. The universities are unable to compete in terms of salary with the industry or private research institutes. The university wage system is largely egalitarian compared to the industry, and the wage level for professors is lower. In general, wage increases may mainly be obtained through advancement to higher academic posts. Once a higher post is obtained, further wage increases are minimal. With obligations for a relatively high number of permanently employed personnel within a limited budget, there is little room for wage increases. For these reasons, some faculties are without the middle generation of teaching personnel.

There are normally other factors than salary which make universities attractive. Availability of laboratories, equipment, a good library, relatively flexible working hours and a favourable academic reputation are among the factors which may make up for the low salary. The possibility to offer good working conditions is closely related to financial opportunities. Even though, efforts should be made to create a favourable working environment. Ideally, wages should not make up more than 70 % of the faculty budget to give sufficient room for the renewal of scientific equipment, in particular.

The universities may offer posts to post-graduate students, provided that there is money available for salaries. External partners may help to provide a place of work and finances to doctoral degree students.

2. THE NEED FOR QUALITY ASSURANCE

The faculty needs to make sure that its courses and research activities reach the required standards. This is the main purpose of the assessment process. Our current practice naturally includes a comparison of results with those achieved in similar courses and research units elsewhere, and the success of graduates in securing relevant employment. External examiners and moderators may provide a valuable viewpoint, and their reports constitute a comprehensive set of evidence concerning standards. Internal staff is certain to have its own perception of the proper standard to be achieved in a certain course. But quality has two aspects: academic standards and client satisfaction measured through students and employers. Therefore, the assessment must involve consultation with appropriately experienced externals. If there is disagreement between internal and external members, the view of the externals should generally prevail. The role of the external examiner is to provide a reference point to enable the standard of the university's activities to be measured against the standard that prevails in the academic community.

Quality assessment is a mean of understanding the effects of our teaching on student learning. It helps to collect information about our research, interpret the information and decide about which actions should be taken to improve practice.

Quality assurance procedures must be designed to work with the national arrangements for maintaining and improving the quality of higher education. These may operate through various national professional and statutory bodies. The involvement of external academics and reviewers is a key element in this approach to quality assurance, because they provide calibration of the standard of awards against others in the sector. External experts bring objectivity and informed judgement about the standards that prevail when comparing the university sector as a whole. This takes place through the process of validation and review.

The overall aim of a programme validation and review is to ensure a high quality of educational and academic experience for students. Its most important function is to assess the quality and standards of programmes. It also stimulates curriculum development by requiring staff to evaluate their programmes and to open them to the thinking and practices of external peers.

External reviewers participate in the process of evaluating existing courses on two occasions. On the first, representatives of industry and business evaluate the existing courses. They get acquainted with the contents of the course and then give a statement on whether the course has satisfied the actual requirements from the point of view of the contents and quality and they make proposals or recommendations for improving the course. This form is not planned and is informal.

On the second occasion, the external reviewers, which are academics from other universities, assess the marking of the subjects. They moderate, but do not mark. The university looks to external reviewers to confirm that the general standard of marking is accurate and consistent with the standards prevailing in the academic community at large, by examining an appropriately broad sample of script. External reviewers will normally be expected to evaluate samples of work in broad terms. On the other hand, external academics take part in this process. Specialists act as lecturers for whole courses or they are assigned lectures on special topics. Whole courses may be held by external academics from other universities, and guest lectures are given by specialists from industry.

The external reviewers have an important function for the diploma work, serving both as consultants and as opponents. The external reviewers and academics also take part in the final exams. They are members of committees for the evaluation of diploma work and for the final examination. The members of the committees are experts and external academics from other universities.

There are some areas with a contribution by external academics in the field of postgraduate studies. The goodwill to consult with postgraduate students and to provide them with expertise and help them with practical experiments is very important and useful for students. For this part, the position of specialist is not important but only his/her experience and knowledge. Specialists from several firms, laboratories and universities make up the basic group of consultants.

The situation is different with external examiners. There are high requirements for the opponents of theses and for members of the examination committees. External examiners must be highly qualified specialists from non-academic institutions or at least associate professors from a university.

External academics and reviewers assess the quality of research in two different ways. In the case of institutional research, results are published each year in a research report which is evaluated by reviewers. The reviewers are academics from other universities, experts from e.g. the road administration or industry. They are proposed by the head of the research team and are approved at the faculty level. A so called “evaluation day” is held every year, when members of the research tem present their work, the reviewers comment on the results in the research report and problems are discussed. After that, reviewers submit their written viewpoint on the results and quality of the research with proposals and recommendations for the next years.

On the other hand, there are research projects approved be the Slovakian Grant Agency. The members of the Slovakian Grant Agency are experts from basic research fields, but there are also many experts from universities and industry acting as reviewers. The quality of research in this case is evaluated for new proposed research projects and for projects underway.

Every year the nominated commission judges new proposed research projects. The review of the projects divided into different quality levels is the base for the budget division between individual research projects.

Projects underway are evaluated every year on the basis of submitted reports. Only conformity between the proposed content of research and the reality is checked at this stage.

Each faculty at Slovakian universities is accredited every three years. The preparation for this process is a annual evaluation of the faculty. The

evaluation and accreditation procedures include pedagogical activities of the faculty; an evaluation of degree courses; graduation level of the faculty including number of professors and associate professors. The next item is the research activity; number and level of grants (from the Slovakian Grant Agency) and publication activities including textbooks, articles and conference proceedings.

The result of the accreditation process is a very important criterion for the budget division. The members of the Accreditation Commission (AC) represent the highest authorities from the universities. The composition of the AC should include authorities from each field of science and AC must be capable to objectively evaluate the qualitative level of the faculty and university.

3. CONCLUDING REMARKS

Any system both intended and designed to regulate human activities, particularly the creative ones, cannot be sustainable and efficient while relying on the exceptional or ideal characteristics of some abstract individuals. The recent historical experience with the socialist system teaches us that an ideal behavioural scheme, which consciously ignores peoples natural interests and needs, simply does not work. Taking into account this human behavioural predisposition, the regulator (faculty management) has in principle two possibilities of assuring the desired output (quality of civil engineering education), i.e.: direct or indirect regulation. The former is associated with both the direct regulatory capture and criteria difficulties. However, this regulatory regime cannot effectively substitute either the competitive market incentives or its coercive power to struggle for better-than-good-enough results. Thus, the indirect regulation by setting up a demanding, competitive external environment which stimulates and forces the faculty to enhance its quality seems to be a more viable method, providing that the internal environment is also competitive and individuals are motivated to share the organisation's values.

The main objective of the paper was to summarise, complete and discuss potential regulation procedures proposed for increasing the competitiveness of CE faculties. Possible difficulties as well as existing constraints on quality enhancement, which could be met in implementation of the proposed measures, were also illustrated.

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NATIONAL OR EUROCODES? HARMONIZATION OF ENGINEERING STANDARDS

Janos Barsony[1]

***ABSTRACT**: The European integration process means a particular challenge for the engineering profession in Central- and East European countries. The Hungarian Universities and the Hungarian Chamber of Engineers (HCE) regard the strategic importance for keeping the level of competitiveness of engineers from the point of view of the global and European integration of Hungary. In 1999 we won a grant from the European Commission for a project, entitled "Harmonization of EU and Hungarian Engineering Standards". The main objective of the project is to strengthen the competitiveness and entrepreneurship of the members of the HCE within the changing needs of the EU environment and labour market. Within the project we had 5 EU partners and 5 Hungarian partners. Last year we delivered a pilot retraining course of EU Engineering Standards and this year a retraining course will be delivered again. The 3 universities – University of Pecs, Budapest University of Technology and Economics, Budapest Polytechnic – are involved in setting up Centres for Excellence offering retraining courses on harmonization of EU and Hungarian Engineering Standards far beyond the life-cycle of the project.*

The aim of paper is to give an overall picture of the situation of the Hungarian issue in the field of the harmonization of engineering standards and to disseminate our course experiences and results (e.g. preparation of common project in this subject).

1. INTRODUCTION

The European process has become an increasingly concrete and relevant reality for the Union and its citizens. Enlargement prospects together with deepening relations with other European countries, provide even wider dimensions to that reality. Such a degree of economic integration is carried out in the European Union so that the free movement of goods, services, people and capital within the Union can be assured. To this goal, there is a need for the harmonization of law and standards. Hungary, as an Associate Member of European Union, is making an effort to join this harmonization effort and to introduce the European Standards in the quickest possible time. Harmonization diminishes trade barriers, promotes safety, allows interoperability of products, systems and services, and promotes common technical understanding.

The Hungarian Universities and the Hungarian Chamber of Engineers regard the strategic importance for keeping the level of competitiveness of engineers from the point of view of the global and European integration of Hungary. In 1999 we won a grant from the European Commission for a project, entitled "Harmonization of EU and Hungarian Engineering Standards". The main target group of the project are the members of the Hungarian Chamber of Engineers.

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2. THE HUNGARIAN CHAMBER OF ENGINEERS

In Hungary the Hungarian Chamber of Engineers conducts and certifies the qualification of professional engineers. The Hungarian Association of Engineers was formed in 1866. It did not function during the communist era. With the social change, the Hungarian Chamber of Engineers (HCE) was again formed in 1989 and it became a public organization in 1996, when the Hungarian Parliament approved the "*Act of Designing and Expert Engineers and Architects*". An engineering diploma and engineering practice (MSc degree + min. 2 years practice or BSc degree + min. 5 years practice) is needed for the membership of the HCE. The authorization to design or to be an expert has more conditions: a required quantity of engineering subjects in the curriculum and a report on the candidate's training and experience. The Hungarian Chamber of Engineers has 19 professional branches (e.g. building, structural, protection of environment, geotechnics, electrical, water management, installation etc.). Every branch has a Qualification Committee. These committees control the candidate's report and the candidate's diploma and on the basis of the diploma and practice they may give the authorization to the applied field.

The Hungarian Chamber of Engineers publishes every year a "Register Book of Authorized Designers and Experts". This book is sent to the professional offices, councils, larger enterprises and to the members of HCE.

3. BASICS OF STANDARDIZATION

Standards are documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose.

International standardization is needed, because the existence of non-harmonized standards for similar technologies in different countries or regions can contribute to so-called "technical barriers to trade".

- *International standardization*:

The World Trade Organization (WTO) is the international organization dealing with the global rules of trade between nations. Its main function is to ensure that trade flows as smoothly, predictably and freely as possible.

ISO (International Organization for Standardization), IEC (International Electrotechnical Commission) and ITU (International Telecommunication Union) have built a strategic partnership with WTO. The political agreements reached within the framework of WTO require underpinning by technical agreements. ISO, IEC and ITU, as the three principal organizations in international standardization, have the complementary scopes, the framework, the expertise and the experience to provide this technical support for the growth of the global market.

The Agreement on Technical Barriers to Trade (TBT) – sometimes referred to as the Standards Code – aims to reduce impediments to trade resulting from differences between national regulations and standards. As far as international consensus-based standards are concerned, the Agreement invites the signatory governments to ensure that the standardizing bodies in their countries accept and comply with a "*Code of good practice for the preparation, adoption and application of standards*", embodied in Annex 3 to the Agreement and which is known as the WTO Code of Good Practice. On behalf of the WTO, the ISO/IEC Information Center records the acceptance of this Code by the national standards institutes.

- *European Standardization*:

At the European level the CEN (European Committee for Standardization), the CENELEC (European Committee for Electrotechnical Standardization) and the ETSI (European Telecommunication Standards Institute) have the task for standardization (elaboration, approval, publishing of standards). CEN has now became the largest regional standards body in the world. CEN's standards are often used outside Europe. Some European solutions have become global solutions and other parts of the world have shown strong interest in the European system of legislation and standards.

European Harmonized Standards are: Category A – Design and Execution, Category B – Product Standards.

With regard to the various types of CEN / CENELEC publication, a basic distinction is made between European Standards (EN) which are established as a general rule and European Prestandards (ENV) which are prospective standards for provisional application.

In the CEN the work is going on in different Technical Committees (TC), e.g. the structural standards for buildings and civil engineering works, the Eurocodes belong to CEN/TC 250.

- *National Standardization*:

At the national level the national standard organizations, the MSZT (Hungary), the DIN (Germany), the BSI (GB), the ASRO (Romania), etc., have the task for publishing of standards.

National Application Documents (NAD): The function of NAD's in the European Code System are to establish a link between the ENV and National Regulations in areas where European specifications are missing.

The European integration means a particular challenge for national standard organizations. In Hungary the MSZT want to achieve a 100% rate of implementation level of European standards by 2002.

4. PROJECT OF THE HARMONIZATION OF ENGINEERING STANDARDS

The main objective of the project is to strengthen the competitiveness and entrepreneurship of the members of the Hungarian Chamber of Engineers within the changing needs of the European Union environment and labour market. Within the project we have 5 EU partners and 5 Hungarian partners: T.E.I. of Athens, Helsinki University of Technology, Finnish Association of Graduate Engineers, Fachhochschule Würzburg-Schweinfurt, Ingenieurkammer Baden-Württemberg, University of Pecs (Faculty of Engineering – Project Coordinator and Contractor), Budapest University of Technology and Economics, Budapest Polytechnic (Faculty of Mechanical Engineering and Faculty of Electrical Engineering), Hungarian Chamber of Engineers and Hungarian Standards Institution. The EU partners gave very important support hosting our teaching staff and experts to collect information for course development. In total 45 people performed 68-week mobility at the EU partners and in addition the same EU partners hosted 25 trainees for practical placement and organized their programs as well.

The project offered 3 pilot courses in the first year (2000) and then 3 retraining courses in the second year (2001) in the fields of Civil, Electrical and Mechanical Engineering, therefore last year we delivered the pilot retraining courses and this year the retraining courses will be delivered. The number of trainees at the 3 pilot courses was 120 chartered engineers (half of them were civil engineers). The pilot courses were delivered in Hungarian but all the courses contained a 1-week professionally oriented intensive English language training, as well. The curriculum of the pilot courses was developed by the Course Development Committee (Civil, Electrical and Mechanical Engineering Working-Groups) and approved by the General Management Group. The members of the Working-Groups were experts of the Hungarian Chamber of Engineers, the Hungarian Standards Institution and lecturers, professors of the Hungarian universities involved in the project as Centers for Excellence.

The 192-hour course structure contained 4 modules as follows:

- Module 1: general module for all the 3 courses, 50 hours in total.

Basics of Standardization in Hungary and in the EU (8 hours); Planning competencies in the EU (8 hours); Information Technology (12 hours); Basic PR knowledge (10 hours); EU procedures for public purchase and tenders (12 hours)

- Module 2: specific professional knowledge of Civil, Electrical and Mechanical Engineering, 70 hours in total of each. For example in the module of Civil Engineering: Structure of Eurocode, Actions (4 hours), Structures of Reinforced Concrete (16 hours), Steel and Composite Structures (12hours), Geotechnics (8 hours), Seismic Design (6 hours), Timber Structures (4 hours), Fire protection (4 hours), Building management (6 hours), Building constructions (1 hour), Masonry Structures (4 hours), Water Supply (5 hours).
- Module 3: 42 hours in total for professionally oriented intensive English language training for all the trainees.
- Module 4: 30 hours in total, practical placement at EU firms for 25 trainees, selected on foreign language skills and professional background and facultative practical placement at Hungarian firms.

The course material was developed on CD-ROM available for the trainees and we combined the traditional and distance-learning methods. According to the timetable each pilot course contained 70 contact lessons within the Module 1 and Module 2 concentrated on Fridays and Saturdays. During the contact lessons the lecturers offered consultations and lectured the most important topics. Beyond the contact hours trainees had to work by themselves elaborating the course material.

The Course Development Committee approved the list of EU and Hungarian engineering standards to be purchased. The Hungarian Standards Institution supported the procurement.

For the quality assurance of the pilot courses we took an opinion poll among the trainees enrolled on the courses. According to the assessment sheets completed by 83 trainees the pilot courses have proven to be useful. The strong majority of the trainees were satisfied. Beside the specific professional modules the PR and Information Technology knowledge proved to be important and all the trainees appreciated the intensive English language training.

In general both the course material development and the delivery of the pilot courses proved to be satisfactory. The global assessment of the course materials and the lectures given by the trainees was “good” or “excellent”. The 3 universities – University of Pecs, Budapest University of Technology and Economics, Budapest Polytechnic – are involved in setting up Centers for Excellence offering retraining courses on harmonization of EU and Hungarian Engineering Standards far beyond the life-cycle of the project.

5. CONCLUSION

The European integration process means a particular challenge for the engineering profession in Central- and East European countries.

Hungary has good hopes of entering the EU in the near future. The specific Hungarian aspects, of a country awaiting EU membership, cannot be ignored. Educating our society is a very important aspect as well as training the engineers who will be directly involved in the accomplishment of EU membership-related tasks. The task of the national engineering associations is to support for nation's European integration strategy. The Hungarian Chamber of Engineers declared its commitment to preparing its members on how to respond to the new challenges of the EU economy. Our experience in the project of training is that Hungarian engineers are motivated to apply European standards. Hungarian engineers have advantages in use of Eurocodes compared to some other colleagues who were accustomed to the use of permissible stresses for a longer period.

When the joining to the EU is very close, it is impractical to spend time and money on the revision and development of Hungarian Standards. The design philosophy of Eurocodes is very similar to the Hungarian Structural Standards. We should direct our efforts to adopt the Eurocodes and to develop the Hungarian National Application Documents.

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PART TWO

Trends and issues in European Civil Engineering Education

THE IMPLEMENTATION AND ACCREDITATION OF BACHELOR/MASTER DEGREE PROGRAMMES IN GERMANY

Günter Heitmann[1]

ABSTRACT: *Germany is presently quite in a phase of experimentation with regard to new higher education structures, programmes and degrees somehow in accordance with the recommendations of Bologna Declaration, but not strictly implementing them. Despite a confusing diversity of programmes in these days, which appears to be in disagreement with the intended harmonisation, the new structures offer some new ways for developing a flexible and adaptable system of higher education in engineering, taking life-long, open and distant learning into consideration, and challenging traditional systems by demands for performance and for quality assurance. In this context, particular emphasis is put on accreditation as a new approach in Germany, seen as a necessary step to achieve quality assurance and hence to pave the way toward international professional recognition.*

1. BACKGROUND AND PERSPECTIVES OF THE IMPLEMENTATION

The Sorbonne Declaration from 1998 and the Bologna Declaration from 1999, meanwhile confirmed by the Prague Communique from April 2001, among other issues recommended the creation of a European Higher Education Space based on a common reference structure of higher education. This two respectively three tier system should consist of an undergraduate and a postgraduate cycle with maybe an explicit third cycle for doctoral studies. Not explicitly agreed and recommended but often mentioned was the idea – stemming from a proposal of the French Attali report - that also the duration of studies should be harmonised and follow a sequence of 3 – 5 - 8 years for the three cycles.

The quoted Declarations and agreements were strongly supported by German authorities and officials. Germany will also be the host for the follow up meeting to Prague which will take place in Berlin in 2003. Since 1998 until the start of the study year 2000/2001 the German Universities and Fachhochschulen have implemented nearly 600 new programmes of study with bachelor and/or master degrees covering all subject areas but with nearly 250 of them in engineering and informatic sciences. An increase to more than 800 can be expected for the year 2001/2002. These programmes are offered in addition to the traditional programmes at Universities and Fachhochschulen with Diplom-, Magister- or State-Exam-Degrees.

But what looks like an unanimously accepted and eager implementation of the Bologna recommendations in Germany was by no means primarily intended as the realisation of the new harmonised European Higher Education Structure leading to more transparency and facilitating mutual academic and professional recognition and

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mobility. On the contrary, it was meant primarily as an attempt to solve some urgent national problems of the German Higher Education system. Discussions on necessary measures started long before 1998. The most obvious reasons are:

- a decreasing attractiveness and competitiveness of studies and degrees from Germany for students from foreign countries even despite the fact that German Universities do not charge fees. Causes for this tendencies were seen in a lack of global recognition of the degrees despite of high quality, long duration of studies up to 7 years and with no degree level in between, language barriers and an unsatisfactory marketing;
- for all students the long factual duration of studies which exceeds the scheduled duration of 4 or 5 years often by another 2 or three years due to high demands, part time studies and the need to earn money in parallel to the studies. In addition the success rate was decreasing with less than 50% in many subject areas and also in engineering education with some better situation at the Fachhochschulen;
- a decreasing rate of enrollment of graduates from the secondary school level in higher education despite the fact that usually in Germany no entrance examinations are required and only Numerus Clausus situations can limit the access. Programmes in Engineering Education in addition faced a dramatic additional cut off in enrollment;
- a general shortage or limitation of public funding for Higher Education raising among others the question whether it is appropriate in the future that about 70 % of the students in Germany follow long cycle programmes of five or more years to a master type of degrees whereas in many other countries nearly two third of the students leave university with bachelor degrees after 3, maximum 4 years at an age of 22 or 23, whereas in Germany the average graduate is mostly far older than 25;
- a lack autonomy of the Higher Education institutions and of flexibility of the existing state controlled Higher Education system to react to new demands of society, economy, professions and the rapid increase of scientific and technological knowledge.

All these reasons contributed to the decision for a new more sequenced structure of Higher Education, the internationalisation of programmes, new decentralised budgeting and management systems of the Higher Education institutions and the implementation of accreditation and explicit quality assurance for all functions of the universities. This was made possible by far going changes of the Higher Education Frame Law followed by respective changes in the Law and the Directives of the 16 German Federal States (Bundesländer) which are responsible for education including higher education. It was accompagnied by special programmes and financial support, e.g. for the implementation of internationally oriented programmes of study and also the implementation of the European Credit Transfer System (ECTS) and accordingly modularisation in all not only the internationally oriented programmes of study.

The perspective of these reforms of higher education is nevertheless not yet clear in the sense that unlike Italy in Germany it has not yet been decided whether the new two tier and consecutive structure of bachelor/master degrees will soon replace the traditional dual system or whether it will be just in addition like now. The German Science Council clearly favoured a quick political decision for a comprehensive replacement, the Conference of the Ministers of Cultural Affairs (KMK) tend to promote a longer pilot phase of experimentation before taking final decisions.

2. FRAME CONDITIONS

The revisited Framework Act for Higher Education from August 1998:

- allows to deliver bachelor and master degrees at Universities as well as at Fachhochschulen
- wants however to keep different profiles of more theoretical or more application oriented kind
- and to limit the duration of studies to a maximum of 5 years for a bachelor plus master,
- demands modularisation and credit points
- and the accreditation of programmes

Since then further specifications have been made by the Conference of the Ministers of Cultural Affairs:

- structural requirements of the new programmes
- implementation of the German Accreditation Council (http://www.akkreditierungsrat.de) and currently the 16 Federal States are in partly different approaches and specifications amending their HE Law. The German Accreditation Council meanwhile authorized several university and state independent Accreditation Agencies to organize the Accreditation procedures following some common rules, among them the „Accreditation Agency for Study Programs in Engineering and Informatics" (ASII) (http://www.asii.de).

  Also the German Rectors Conference (HRK) contributed with various recommendations (http://www.hrk.de).

3. ACCREDITATION AS A NEW APPROACH OF QUALITY ASSURANCE IN GERMANY

Accreditation is quite a new approach in Germany. It was introduced by the new Law as a necessary step of quality assurance in connection with the implementation of the new Bachelor/Master Programmes but with the option to replace the tradional approval patterns by Federal state Authorities which are still in use for all other degree programmes. These approval procedures start from the design or revision of a certain programme of study including the examination and assessment regulations by the university or department concerned. It should correspond to certain general frame recommendations of the KMK, the Conference of the Ministers of Cultural and Educational Affairs. These frame regulations form the background or the benchmark against approval is decided and given by the respective Federal State Ministry. After approval the programme can be offered by the university and somehow also the financial support of the implementation by the state was checked or taken for granted.
With actual processes of decentralisation, funding and budgeting and in the light of recent experiences it turned out that this approach is time consuming, inflexible and even not appropriate with regard to newly demanded qualifications. Therefore programme accreditation was installed as an even internationally better known step of quality asssurance. Unlike in most other countries where accreditation of programmes is in use especially in the context of professional recognition and with regard to only a certain number of subject areas, the German appoach shall cover all subject areas and both the bachelor as well as the master level. It will have quite an academic bias as the

newly founded Accreditation Agencies which have to be authorized by the meanwhile installed German Accreditation Council and will be responsible for detailing of the accreditation criteria and standards and the organisation of the procedures are not in the hands of professional organizations like ABET in the USA or the Engineering Council in the UK but show quite a big representation and influence of Academia.

The Accreditation Agency for Study Programs in Engineering and Informatics for instance is built and equally shared by four parties: the traditional (Technical) Universities, the Universities of Applied Sciences (Fachhochschulen), the Professional Organizations and the Associations of the Employers. However, the State influence is reduced even though still a programme will not start without an o.k. by the State or can still start without an ex ante accreditation if an accreditation ex post is scheduled or intended. This explains why only very few of the quoted 600 new programmes, even if students can enrol and study, are already accredited.

The Accreditation Council has fixed some general rules regarding criteria and procedures of accreditation which have to be specified by the respective agencies. The general rules referring also to the new Law imply that besides of modularization and ECTS the new programmes may have different, either more theoretical or more application oriented profiles documented in the degree types of either Bachelor or Master of Sciences or Arts, respectively Bachelor or Master of a specified application area like for instance Electrical Engineering. They also may have different durations: 3 to 4 years for a bachelor degree, 1 to 2 years for a master, not more than 5 years for a consecutive Bachelor / Master programme. As a result the current offer of new programmes show a vast variety of durations and degree types. Therefore, what was intended on the European level as a kind of harmonization referring to a common basic structure and facilitating transparency and recognition currently at least for Germany turns out to arrive at an increased diversity with additional problems as far as transparency and even mutual recognition even in Germany itself is concerned.

By the new Frame Law it was also required that both new programme and degree types should somehow be focused on employability. It is far too early to answer the question whether this aim can be achieved by three years programmes of study, particularly taking into account that in most subject areas like for instance engineering no additional structured phase of Initial Professional Development is demanded for a professional qualification. From this point of view it is not surprising that nearly 50 % of the new programmes is built of various new postgraduate master programmes of one to two years duration with an access requirement of a bachelor level.

4. CURRENT SITUATION IN ENGINEERING EDUCATION

In engineering the Fachhochschulen, previously restricted to bachelor type of degrees only, took the opportunity to increase the variety and level of their programmes and their reputation by offering quite many Master of Science or Master of Engineering programmes and degrees. In due course the traditional research universities used the chance to market their comparably outstanding research expertise by offering specialized Master of Science degrees. It also allows the introduction of special access requirements which in Germany is normally not possible because of an open access to higher education based on the secondary shool exams (Abitur or Fachhochschulreife) and even the opportunity to in the long run charge fees if courses are taken by students from foreign countries or by applicants from industry.

The ASII meanwhile fixed the general demands for engineering programmes and also established Technical Committees in 8 Engineering Subject Areas for the determination of specific demands in these areas and for qualifying and nominating peers for the audit teams. The procedure itself follows the internationally applied patterns with application, structured self-reports, on site visits of audit teams and a peer review and recommendation for a final decision of the Accreditation Council of ASII. Also the criteria do not differ significantly from ABET Criteria 2001 and other approaches despite the fact that due to obvious reasons (no graduates yet) the American approach of performance and outcome orientation is not that much applied yet. Not surprisingly therefore general demands still rely on input criteria like certain percentages of subject hours in special areas like:

Shares of subject groups in Bachelor Programmes:

Minimum

20 %	Math. and Natural Sciences
25 %	Subject specific basics
15 %	Specialisation
10 – 15 %	General subjects

3 month for final thesis

3 month for practical stages and internships.

As you may register there is still the attempt to include practical stages and final thesis work as a good tradition of German engineering education. Often the duration for these parts is extended to 6 month causing extensions of the bachelor programmes to 7 semester at Technical Universities or even 8 semesters at Fachhochschulen if the programmes are not part of a 3 plus 2 consecutive scheme.

Programmes should be modularized and based on ECTS. There is still a debate on the size and character of modules. With regard to credits the well known ECTS frame of 60 credits per year is accepted, representing 1800 hours of student workload or 30 hours per credit. This differs from countries where one credit amounts to 40 hours, also from other countries like UK where the credits per year in many cases should be 120, or the USA where they are less than 60. Therefore comparability is still quite a problem not only because of the formal frame but also because of the unsolved question of the compatibility of contents and demands of certain modules and the quality the respective credits stand for.

Quality assurance and appropriate documentation of quality is therefore not only a problem in the context of ECTS, national and international credit transfer and accreditation but also a continuous concern of the universities and departments. As accreditation is felt as a means ensuring a certain satisfactory minimum standard, often from a professional point of view only, many academics have the feeling that they achieve much higher quality which should be also expressed if not by accreditation then by quality evaluation and/or additional quality labels. It is in the line of this debate that many of the Technical Universities of Germany in a position paper defined additional specifications for the two profiles of engineering education and proposed on an international level the development of a label or certification for programmes of study which are determined by demands higher then those of the accreditation and by innovative programme design. (see: Positionspapier zur Ingenieurausbildung an Technischen Universitäten und Hochschulen in Deutschland).

Regarding the future development of bachelor and master programmes in engineering and in informatics education in Germany it is already obvious that the number of programmes will increase to about 350 at the beginning of the new semester 2001/2002. However, the development of one and two year master programmes continue to prevail, consecutive schemes are about 25 percent only and stand alone bachelor degree programmes are still offered with an unclear picture about the willingness of industry to employ these kind of graduates. It is felt that a master type of initial education, either in an MEng version like the Diplom-Ingenieur from the Fachhochschulen or in an MSc version like the Diplom-Ingenieur from the Technical Universities is needed as a first step into professional life. Not surprisingly the German universities therefore argue for a conservation of the long cycle 5 years programmes leading directly to a master degree and to not replace them completely by consecutive bachelor/ master schemes. This position is even stronger emphasized by the civil engineers than by other engineering branches.

5. HOW FAR IS CIVIL ENGINEERING INVOLVED?

Due to the mentioned position it is not astonishing that up to now only very few departments of Civil Engineering decided to offer in addition to their Diplom-Ingenieur programmes bachelor or master degree programmes. Besides of some specialisations available through one or two years master courses and addressed to applicants with a bachelor or Diplom-Ingenieur degree if not offered as continuing education the general approach taken looks to be the offer, to leave a normal long cycle programme in between after about 7 semester with a bachelors degree after a slightly different choice of modules in the 5th and six semester, some additional exams and the delivery of a thesis work. Types of these kinds of programmes can be found at the Technical Universities of Dresden, Hannover and Darmstadt. In many ways these programmes do not satisfy the political demand for a special shape of the new curricula focused on employability.

Also because of a currently decreasing demand for Civil Engineers on the labour market it can not be expected that this situation will change significantly towards an increasing implementation of bachelor degree programmes with a duration of 3 years.

As a conclusion, it can be said that Germany is in quite a phase of experimentation with regard to new structures, programmes and degrees according somehow to the recommendations of Bologna but not strictly implementing them. Whether in the near future a situation will be achieved where the new structures by political decision like in Italy will replace the traditional ones is still an open question. However, what can be said at the moment is that despite of a confusing diversity of programmes in these days in contrary to the intended harmonisation the new structures offer quite some new ways for a flexible and adaptable system of higher education, taking life long and open and distant learning into consideration and challenging traditional programmes by demands for performance and outcome orientation and a systematic quality assurance. And all together it therefore looks like a big chance and a step forward.

HIGHER EDUCATION IN ITALY: THE TRANSITION PHASE FROM OLD TO NEW SYSTEM

Diego C.F. Lo Presti & M. Lodovica Tordella[1]

***ABSTRACT**: In the last decade the Italian government has started to change the higher education system in the framework of a project aimed at modernizing the country and, in particular, at pursuing the harmonization of the higher education system within the European Community. The main aspects of the new system can be summarized as follows:*

a) Students graduate a first degree in three years (180 credits), and a second degree (specialization) in another two years (120 credits);
b) Master courses are available at the end of the first three years and of the next two years as well;
c) Ph. D. courses are available at the end of the specialization degree;
d) The Universities are relatively free in establishing curricula, admission criteria, fees, pre-requisites etc.

The main objectives that should be achieved by means of the new system are: a) to reduce the number of students that give up studies, b) to reduce the number of years that are necessary to graduate laurea (actually on average 7 years for the civil engineering laurea), c) to increase the number of graduated people in the country. This paper describes, by comparison, past and current systems, points out the main problems arisen during the transition phase and provides a first evaluation of the new system capability in achieving the intended objectives. Of course the above-mentioned comparison and judgment is referred to the Civil Engineering Course. Among the many problems arisen and not yet solved, that one concerning the relationship between University and Professional Association seems to be crucial.

1. INTRODUCTION

Historically, higher education system in Italy was quite inflexible and aimed at graduating a relatively small number of highly qualified people. Course duration ranged from a minimum of 4 years to a maximum of 6 years depending on the type of studies. Fundamental subjects, for a given graduation course, were fixed by the Ministry of University and Scientific & Technological Research (MURST) and represented on average about 90% of the total subjects, which should have guaranteed, at least in principle, a uniform preparation of graduates. A final thesis was required in order to graduate. The time necessary for thesis preparation ranged (in the case of Civil Engineering) from 4 months to about 1 year. Generally, no admission test was necessary and fees were relatively low. In any case fees did not cover the real cost.

According to the Latin cultural heritage, the teaching of a given subject consists firstly in stating the basic principles and secondly in applying those principles to solve practical and simplified problems. In other words, the education is based on a

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deductive method. It is possible to recognize the same structure in the graduation-course organization.

As an example, the Civil Engineering was a five-year course consisting of 30 subjects more or less equivalent to 300 credits. The first and second years were devoted to providing the students a strong mathematical-physical basis and in general the necessary tools (chemistry, drawing, etc.). Third year and part of the fourth year were devoted to giving the specific education (strength of materials and solid mechanics, construction of buildings, hydraulics, geotechnics, construction of road, railway and airport, etc.). Part of the fourth year and fifth year were mainly devoted at obtaining a specialization. In particular four specializations were available: structural, hydraulic, geotechnical & transportation. Appendix A1 shows a typical curriculum for Civil Engineering (Geotechnical specialization).

The University degree is a necessary requirement in order to practice. Another requirement is to become chartered practicing and consequently member of a given Professional Association. The rules to become chartered practicing are different depending on the type of profession. Graduates in Civil Engineering become chartered engineers by taking an examination just after the degree. Such an examination consists of the design of a simple structure (retaining wall, swimming pool, shelter, etc.) that has to be completed in 8 hours and a colloquium. Members of the Engineer Society and of Academia are charged with such an examination. In the light of what explained above, the expression "*chartered engineer*" that means expert or senior engineer, should be replaced with "*certified or authorized engineer*".

In conclusion, the idea behind the previously outlined system is that the State guarantees a given uniform preparation and capacity of practicing, at least in principle.

The National Society of Engineers (Ordine Nazionale degli Ingegneri) takes a register of certified or authorized engineers. There is a register for each Province and it is unique for Civil, Mechanical and Electronic engineers. The main practical consequence is that any registered engineer can sign designs in the field of Civil Engineering irrespective of his specialization. Such a situation is a direct consequence of quite uniform curricula in Engineering as far as the past system is concerned.

The main limitations of the previously described system can be summarized as follows:

a) The number of graduates is low and generally is not sufficient for the needs of a modern society.
b) Highly qualified graduates after many efforts and years of studies often find an occupation that is below their capacities, which causes many frustrations.
c) The absence of admission tests and the general low level of fees cause a tremendous waste of resources.
d) In-fact there is a very large number of young people that attempt to graduate and soon give up.
e) The rules to become chartered engineer are very soft and do not involve a training period.

In order to overcome the previously indicated limitations, the Italian government, in the last decade, has started to change the higher education system in the framework of a project aimed at modernizing the country and, in particular, at pursuing harmonization of the higher education system within the European Community. This paper tries to show the innovations introduced by the new system, in comparison to the old one, and to point out the problems arisen during the transition phase. To avoid confusion, the old system degree will be called LAUREA.

2. SOME STATISTICAL DATA CONCERNING OLD SYSTEM

In order to better understand the old system, some statistical data are reported in this chapter. Data have been taken from MURST 2001. Table 1 summarises the information concerning the number of students enrolled and that of graduates.

Table 1 Students enrolled and graduates

University	Students	Students (1st year)	Graduates
All (*)	1.612.734	247.796	133.199
Civil Engineering (+)	28.991	3566	2352
Politecnico di Torino (*)	20.260	2388	1989
Civil Engineering (Politecnico di Torino) (+)	1310	161	123

(*) No. of students for the academic year 1998/99 & graduates in the academic year 1997/98
(+) No. of students for the academic year 1998/99 & graduates during 1998.

In order to appreciate the data reported in Table 1, it is worthwhile to mention that the number of graduates in Italy in 1998 is of about 14% (i.e. 14 graduates over 100 people of the same age). In other countries higher percentages have been observed in the same year (France 24, Belgium 16, Portugal 17, Germany 16, UK 45, USA 45, Austria 14, Spain 28). It is important to remark that, as far as other countries have been considered, the number of graduates include different kinds of degrees. The above-mentioned statistics refer to all University studies. As far as Engineering is concerned, a different distribution between short and long term courses is possible. In any case, the percentage of graduates in Italy remains low in comparison to other developed countries.

Figure 1 shows the data above mentioned.

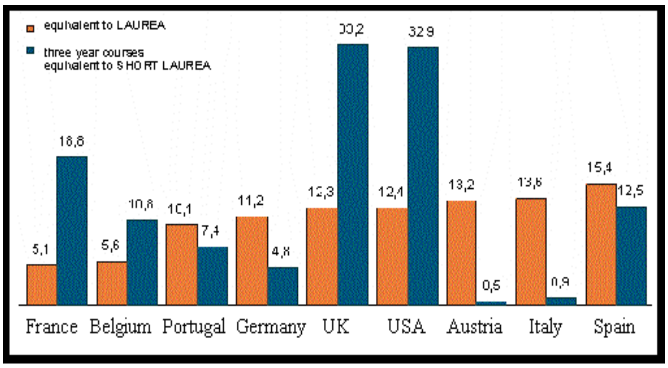

Figure 1 Graduates in different countries

Figure 2 shows the % of undergraduates at the first year in different countries. As far as Italy is concerned, there are a quite large number of young people that initiate the university studies. Unfortunately, only 40% of the undergraduates are able to complete the studies (ISTAT 2001). Young people give up studying within the first two years. As far as the Politecnico di Torino is concerned, about 27% give up studying within the first year (25% in the case of Civil Engineering). The above percentage represents the average for the period from 1998 to 2000. For the year 1997, the giving up, for Engineering, is on average 25.1% in Italy (SIA, 2001).

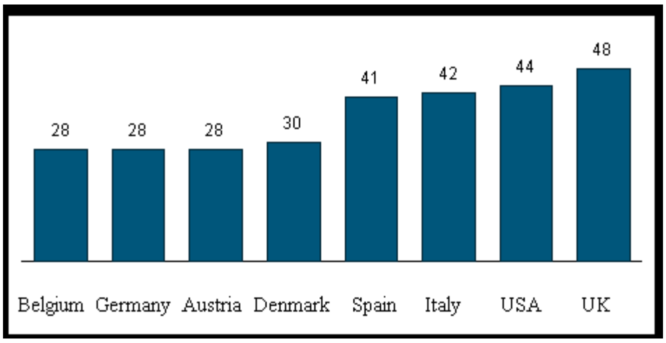

Figure 2 Undergraduates at the first year

Another important aspect is the real duration of studies. Table 2 shows the number of regular undergraduates and graduates over the total number of students.

Table 2 Study-regularity

University	Total No. of students/ No. of regular students	Total No. of graduates/ No. of regular graduates
Civil Engineering (+)	28.991 17.256	2352 242
Civil Engineering (Politecnico di Torino) (+)	1310 519	123 17

(+) No. of students for the academic year 1998/99 & graduates during 1998.

The regular graduates are those that have concluded their studies within the established period (5 years for Civil Engineering). The regular undergraduates are those that have passed a certain number of examinations per year. The percentage of regular undergraduates ranges in between 40 and 60% of the total number of undergraduates, while that of regular graduates is of only 10 to 15%. Higher number of regular undergraduates (60%) is observed in small Universities.

Many students do not succeed in passing examinations, which is the main reason for having non-regular undergraduates and increasing the real duration of studies. Table 3 shows, in the case of some fundamental subjects, the number of passed examinations in comparison to the total number of students for that subject in a given year (1999).

The percentage of successes ranges in between 60 and 90%. Accumulation of several failures at examinations is the main reason for having non-regular undergraduates.
In order to better understand the importance of this aspect it is worthwhile to provide more statistical data. Table 4 shows for the year 1999 the number of regular and non-regular students per year.

Table 3 Passed examination (Civil Engineering at the Politecnico di Torino) (year 1999)

Subject	Total No. of students	Total No. of Success
Mathematics I	325	275
Mathematics II	308	235
Physics I	324	283
Physics II	302	220
Solid Mechanics	364	211
Hydraulics	361	330
Construction of building	362	203
Construction of road	217	176
Geotechnics	250	194
Rock Mechanics	180	174

Table 4 Success in University-studies (year 1999)

	Politecnico di Torino (%)	Other (%)
Regular	7.8	9.0
Non-regular 1st year	20.9	16.5
Non regular 2nd year	23.2	20.5
Non-regular 3rd year	17.0	17.2
Non-regular 4th year	12.3	12.7
Non-regular 5th year and next	17.3	23.8

It is obvious that what is depicted in Table 4 leads to an increase of the effective period of study. For example the same database used for Table 4 (AlmaLaurea 2000) indicates an average period of 7.3 years to graduate at the Politecnico di Torino and of 7.1 year to graduate in other Universities and Faculties.

More specifically, considering the Civil Engineering course in 10 different Universities the age of graduate students is that reported in Table 5.

Table 5 Age of graduates (Civil Engineering 10 Universities – Politecnico di Torino) (year 1999)

Age of graduates (years)	Other	Politecnico
Less than 25 (%)	8.9	22.4
From 25 to 26 (%)	40.5	52.7
More than 27 (%)	50.6	24.8
Average age (year)	27.8	26.5

3. THE NEW SYSTEM

The main aspects of the new system can be summarized as follows:

a) Students graduate a first degree in three years (180 credits), and a second degree (specialization) in another two years (120 credits). These two degrees are in series, i.e. after the first level graduation it is possible to continue the career without paying any cultural “debt”. To avoid confusion the first degree will be called SHORT LAUREA while the second degree will be called SPECIALISED LAUREA.
b) Master courses are available at the end of the first three years and of the next two years as well. In this contest, the Master Course has a different meaning than usually. Master Courses deal with very peculiar topics and consist of about 500 to 600 hour lectures taught by people coming from both the professional and academic world. As an example, the II Faculty of Engineering in Vercelli (Politecnico di Torino) has established a Master Course on Public Work Management. Such a course is offered to those who graduate SHORT LAUREA.
c) Ph. D. courses are available at the end of the specialization degree.
d) The Universities are relatively free in establishing curricula, admission criteria, fees, pre-requisites etc.

As an example, the II Faculty of Engineering in Vercelli has established an admission test. The test is divided into four sections: text understanding, mathematics, logic & physics – chemistry. It is sufficient to obtain a grade of 401 over 1000 to pass the test. Anyway, 50 % of the grade is due to the higher-school mark that ranges from 300 to 500. From this point of view the test has only a psychological effect and only serves to select motivated students. Most importantly, those students who pass the test without obtaining a 200 grade in the mathematics section are obliged to attend a pre-University class consisting of 40-hour lecture in mathematics. A final test to assess the improvements is done at the end of this two-week course. Those students that do not pass such a test have to follow curricular studies different than the other students.

The admission test adopted by the I Faculty of Engineering is quite different than that above described.

The new system is much more flexible than the old one. The MURST has fixed the minimum number of credits that should belong to a given cultural area. As for the first degree, which consists of 180 credits, a minimum of 27 credits should belong to the area of Mathematics, Physics and Chemistry, 36 credits should characterise the graduation course (for example Civil Engineering), 18 should belong to cultural areas close to that of the graduation course (for example other Engineering course) or different cultural areas (Human Sciences, Economics & Law, Social & Political) 9 credits are for the thesis preparation and for the foreign language. An example of curriculum in Civil Engineering is shown in appendix A2 (II Faculty of Engineering in Vercelli). The I Faculty has adopted different curricula, introducing specialization even during the first three-year course. The writers do not evaluate positively such a decision. Therefore the Universities are quite free in preparing curricula and also have the possibility of establishing admission criteria, fees, pre-requisites etc.

More interestingly, it is to notice that the teaching of Mathematics is not restricted to the first year but, for those who want to graduate the specialization “Laurea”, advanced subjects of Mathematics are taught during the third year (see A2).

The fact that basic subjects are taught even in the higher degree courses (SPECIALISED LAUREA & Ph. D.) is a basic requirement for the system functionality. The adoption of an inductive teaching approach should be another fundamental aspect.

The new system has been experienced since one year and two years at the main Campus of the Politecnico di Torino and at that in Vercelli (II Faculty of Engineering of the Politecnico di Torino) respectively. Therefore it is quite premature to draw definitive conclusions especially considering that Vercelli is a small University and, as already pointed out, the situation in small Universities is better. Anyway it is possible to give some indications.

As a first indication, the number of enrolled students is increased after the adoption of the new system as shown in Table 6.

Table 6 No. of students enrolled

Year	A	B
1998	148	1944
1999	123	1719
2000	141	1271
2001	169	1609

A Civil Engineering at the Politecnico
B Engineering at the Politecnico

It is quite obvious that, after a continuous decrease of the number of students from 1998 to 2000, there is a sudden increase with the adoption of the new system in 2001. The decrease in the number of students was probably due to the awareness of the fact that studies in Engineering last even more than 7 years, are quite hard and occupation conditions do not compensate the efforts supported to graduate.

The main problem faced during the transition phase was the overlapping of classes and examination period. To solve this problem the academic year was divided in three periods consisting of 10 weeks for lecturing and at least 20 days for examinations. Such a calendar was adopted for both old and new systems.

It is too early to draw conclusions concerning the student career with the new system and the study regularity.

Some considerations can be done concerning the occupation of the graduates with the new system:

a) The first consideration is based on a previous experience in Italy concerning three-year courses called DIPLOMA. The DIPLOMA degree was introduced about 10 years ago and was in parallel with LAUREA degree, that is students graduating DIPLOMA should pay a cultural "debt" to graduate LAUREA. The payment of a cultural debt means integrative studies and examinations. A limited number of students graduated DIPLOMA. In 1998 about 14 % graduated LAUREA, as already stated, while only 0.9 % graduated DIPLOMA. Anyway, 75.2% of those that graduated DIPLOMA found an employment or occupation related with the studies undertaken, while only 67 % of those that graduated LAUREA were in the same condition. The percentage of employed graduates approached 80 % in the case of DIPLOMA degree in Engineering. This means that there are very good opportunities of occupation for three-years course graduates.

b) Engineer Society has not accepted positively the new system, which represents a big problem especially in the case of Civil Engineering. The crucial points are i) the role of Engineer Society and ii) the rules to become chartered (certified or authorized) engineer. The writers believe that the role of Engineer Society should be more cultural and less bureaucratic. This means in turn that the admission to the Society should be based on effective work-experience instead of a formal and "academic" examination of graduates without any experience.

Very recently, Italian Government has defined the rules to become chartered (certified or authorised) engineer.

The graduates are admitted to the Society by taking an examination as in the past. Anyway graduates are divided in two "sections": section A for graduates with SPECIALISED LAUREA degree (engineer, able to apply advanced and innovative methodologies) and section B for graduates with SHORT LAUREA degree (junior engineer, able to apply standard methodologies).

The examinations are obviously different for the two sections.

Another important innovation is represented by the fact that the engineer register is divided into three sections for a) civil and environmental engineers, b) mechanical engineers and c) electronic engineers.

It is worthwhile to notice that the previously mentioned DIPLOMA course was in parallel with LAUREA thus requiring parallel classes in various subjects. DIPLOMA courses will disappear soon in the mean time that the new system will develop. The new system does not involve parallel classes, therefore the new system will reduce the costs of higher education in Italy or, at least, will not increase them.

4. CONCLUSIONS

In the last decade a big effort has been done by the Italian Government to modernize the higher education system in Italy. The main objectives of the Government project were: a) to reduce the number of students that give up studies, b) to reduce the number of years that are necessary to graduate LAUREA (actually on average more than 7 years for the LAUREA degree in civil engineering), c) to increase the number of graduates.

It is too early to give a complete evaluation of the results of the new system. Anyway two things are very clear:

1) the number of students has increased with the adoption of the new system
2) the occupation opportunity for three-year course graduates are very good

Contrary to what declared by the new Italian Prime Minister during the recent electoral campaign, the new Italian Government seems to be willing to confirm the new higher education system. In any case the writers believe that the new system will require some adjustments in the next future.

ACKNOWLEDGEMENTS

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Appendix A1

Year	1st Period	2nd Period
1st	Mathematics I Chemistry Drawing I	Analytic geometry Physics I Drawing II
2nd	Mathematics II Physics II Computer programming	Theoretical mechanics Economics Topography
3rd	Solid Mechanics Hydraulics Materials Science & applied chemistry	Structures Building analysis (use & maintenance) Geology
4th	Rock Mechanics I Hydraulic constructions Y(1)	Geotechnics Heat transmission, acoustic & illumination design Reinforced concrete & pre-stressed concrete constructions
5th	Foundations Roads, railways & airports Y(3) Y(4)	Municipal engineering Rock Mechanics II Y(4)

Y(1), Y(3) & Y(4) = selected by students among various subjects contained in a list.

Appendix A2

Year	1st Period	2nd Period	3rd Period
1st	Mathematics I (5) Economics (4) European Culture (2) Computer Science (4) Drawing (4)	Mathematics II (4) Linear algebra (5) Mechanics (5) Electromagnetisms & Optics (4)	Chemistry (6) Statistics & probability (5) CAD (5) Multidisciplinary project (3)
2nd	Electric circuits (4) Hydraulics I (5) Materials Science & applied chemistry (5) Topography (5)	Building industry (5) Mathematics III (7) Thermodynamics (5) Theoretical & applied mechanics (5)	Solid mechanics (10) Methods of cost evaluation (3) Heat transmission, acoustic & illumination design (5) Multidisciplinary project (3)
3rd	Constructions (10) Building analysis (use & maintenance) I (5) Hydraulics II (5)	Aqueducts & sewerages (5) Geotechnics I (5) Theory of traffic I (5) Roads, railways & airports I (5)	Mathematics IV (6) Multidisciplinary project (4) Training (5) Final examination (5) English (5)

Credits are in brackets. Those students that do not want to undertake the second level degree are allowed to replace some of the subjects (mainly mathematics) of second and third year with more practical subjects not listed here. In total about 20 credits can be replaced.

Students that graduate the above-described three-year course will have a robust mathematical-scientific culture and some professional capacity. It is supposed that they will find a job in: a) consultant companies, b) building industry firms, c) technical staff of Municipalities or other local administration, d) civil-engineering yard. As far as design activities are concerned, it is supposed that they will be able to apply standard methodologies.

NEW TRENDS IN CIVIL ENGINEERING CURRICULA AT SLOVAK UNIVERSITY OF TECHNOLOGY

Jozef Dický [1]

ABSTRACT: *System of higher education, specially technical, has been permanently influenced by many factors as: using new materials and technologies, developing new methods and information technologies etc. This paper is dealing with an influence of some aspects on changes of civil engineering programmes at the Slovak University of Technology (SUT) in Bratislava. Author describes briefly the structure of civil engineering programmes and curriculum, the particular stages of gradual changes from the one-stage to two-stage programmes as well as knowledge and experiences from this process. The changes (regarding the time and content) among the old and new programmes as well as their expected contribution are compared.*

1. INTRODUCTION

During the recent years the system of civil engineering education in Slovak Republic has been influenced by several important aspects of its developing; the most important are as follows:

- the political and economical changes in society and intensifying of the academic freedom of universities,
- rising of the independent Slovak Republic grounded on the Czechoslovak tradition,
- effort of the incorporating to the European and Trans-Atlantic structures,
- an intensive developing and using of new materials and technologies in civil engineering branch,
- fast changes in using the software products during the design of buildings and structures and management the building processes.

These and other aspects also play an important role in changes of existing and developing new programmes as well as an adaptation of their curricula to the new, permanently changing conditions.

Author presents some experiences reached by his long teaching praxis with the changes of the teaching methods used in structural mechanics and the design of structures under the recent trends. The area of statics and dynamics of structures has always been one of the crucial points of the design of structures.

In past the education of civil engineers was grounded on the time-consuming practical calculations done by hand or by support of simple computing technique. The huge developing of the computers and new numerical methods and software in recent years change very rapidly the process of design structures using the CAD. More and more engineers and students are able to use their computers during their study and work, what brings the new problems in changes of the teaching methods in structural mechanics.

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Another important component of civil engineering education in conditions of the unifying of European countries is the process of the gradual harmonisation of the civil engineering programmes at particular universities in Europe. In last part of paper author expresses his opinion in this process and deals with the positive results reached in the international project EUCEET as well as the possible ways in some future common European Civil Engineering Education Projects.

2. CIVIL ENGINEERING EDUCATION AT UNDERGRADUATE AND POSTGRADUATE LEVEL

Engineering education is one of the most extended part of tertiary stage of education in Slovak Republic. The institutions dealing with the engineering sciences are called "Technical University" or "University of Technology". Our Faculty of Civil Engineering was founded in 1938 as the first faculty of Slovak University of Technology (STU) in Bratislava. More than 25 000 MSc. students and 900 PhD. students has graduated from the Faculty during its history. A new system of study introduced after 1989 at the Faculty has recently been further updated to a credit-based modular-unit-system.

The first stage is the undergraduate course providing the education in four basic civil engineering branches with the three years duration (180 credits) completed by a final thesis awarded with BSc. degree. The minimum requirements for admission are based on the pre-university certificate level. All applicants pass the university entrance exam mainly on mathematics and physics. This stage gives the student the theoretical background necessary for further specialisation together with the basics of civil engineering. To broaden the students´ educational perspectives, courses in the arts and social sciences, including laws, philosophy, sociology, psychology and aesthetics, have been added to the curricula. There are two semesters in each year of study - winter semester (13 weeks lectures from October to January) ensued by 6 weeks session, and summer semester (13 weeks lectures from March to June) ensued by 8 weeks session. The programmes consist of 30-35 subjects (10-12 each year). The lectures, exercises and laboratory are taught in 28 contact hours per week, 50% lectures, 50% exercises and laboratory. The final exam comprises the presentation of the short final project and the exam from one of the core subjects. The final assessment consist of average mark of all subjects assessed during study, the mark of final project and the mark of final exam.

The second stage - the post-graduate course providing the continual education in eight specialised engineering branches with two years duration (120 credits) aimed at developing special skills in the chosen specialisation, is completed by a diploma thesis and awarded with MSc. degree. It permits students to implement their individual goals for their vocational education and specialisation. Students are enrolled either after completing their BSc. studies in Civil Engineering branch or BSc graduates from earlier period on the base of their final studies mark and the interview. There are two semesters in first and second year of study - winter semester (13 weeks lectures from October to January) ensued by 6 weeks session, and summer semester (13 weeks lectures from March to June in first year and 8 weeks lectures from March to May in second year) ensued by 8 weeks session. The programmes consist of 20-24 subjects (10-12 each year). The lectures, exercises and laboratory are taught in 26 contact hours per week, 40% lectures, 60% exercises and laboratory. The final exam comprises the presentation of the diploma project and the exam from two core subjects. The final assessment consist of average mark of all subjects assessed during study, the mark of diploma project and the marks of final exams. Thereafter, three-year PhD. study programmes in ten major civil engineering sciences are offered to students with the MSc. degree.

The general view on bachelor, master and doctoral degree programmes taught at Civil Engineering Faculty SUT in Bratislava is presented in Tab.1.

Table 1 Bachelor, Master and Doctoral Engineering Programmes Taught at Civil Engineering Faculty STU in Bratislava

BSc. Programmes	**MSc. Programmes**		**PhD. Programmes**
Year of study	Year of study		Three Year Programmes
First / Second / Third	First	Second	
Semester	Semester		
1^{st} / 2^{nd} / 3^{rd} / 4^{th} / 5^{th} / 6^{th}	1^{st} / 2^{nd}	3^{rd} / 4^{th}	1^{st} / 2^{nd} / 3^{rd}
CIVIL AND TRANSPORT ENGINEERING	Civil and Transport Engineering	Concrete Structures Steel &Timber Structures Geotechnics Roads and Airports Urban Traffic Engineering Railways	Theory and Construction of Civil Engineering Structures Applied Mechanics
WATER MANAGEMENT AND WATER STRUCTURES	Water Management and Water Structures	Hydrotechnics Water Resources Management Sanitary Engineering Water Geotechnics	Sanitary Engineering Hydraulic Engineering Hydrology and Water Resources Management
GEODESY AND CARTOGRAPHY	Geodesy and Cartography	Geodesy Geoinformatics Engineering Surveying Land Consolidation and Cadastre Geography and Mapping	Geodesy and Geodetic Cartography
BUILDING STRUCTURES	Architecture and Building Structures	Architecture Architectural Structures Statics Urban Engineering	Theory and Construction of Building Structures
	Building Services	Sanitary Equipment Heating Ventilation and Climatization Systems	
	Material Engineering		Science of Non-metallic and Building Materials
	Building Technology		Building Technology
	Economics and Building Industry Management		Industrial and Sectorial Economics

As you can see from the table, first two semesters in second stage are common for each Civil Engineering Programme, but some of them are divided in last two semesters to smaller groups according to the specialisation. These groups have some common and some different subjects.

3. CIVIL AND TRANSPORTATION ENGINEERING PROGRAMME

Civil and Transportation Engineering Programme is one of the most important programmes at our faculty. Graduates of this programme are qualified not only to perform structural design but also organise and manage civil engineering works such as the construction of bridges, high-rise buildings, industrial structures, foundations and underground structures, as well as special building constructions made of concrete, masonry, steel, timber, soil, rock and newly-developed composites. They are further qualified for the planning, management, implementation, maintenance and reconstruction of transportation-related structures (roads, motorways, railways, airports) and work in the related fields of urban network planning, transportation infrastructures and traffic engineering. To be able to work successful in areas mentioned above student must pass more than 50 different subjects, some theoretical and some practical. Author selected some subjects, which in his opinion play the most important role in this programme and compared the amount of the contact hours in some programmes from 1950 to 2000 years. The comparison is presented in Table 2. In the table the last is the two-stage programme, all other are the one-stage programmes. As it is seen, the total number of contact hours were during 50-90 years practically constant and they felt rapidly (about 20%) in last years.

Table 2 Number of contact hours of the core subjects of Civil and Transportation Engineering Programmes during 1950-2000

Programme	**1950**	**1960**	**1966**	**1980**	**1990**	**2000**
	Contact hours during the study					
Mathematics	273	299	494	390	338	273
Physics	91	130	130	130	117	104
Drawing Geometry	130	117	130	52	52	104
Structural Mechanics	403	455	481	468	416	286
Mechanics of Materials	65	52	143	182	169	156
Concrete Structures and Bridges	364	390	338	325	247	299
Steel and Timber Structures and Bridges	377	364	273	299	299	260
Foundations and Underground Structures	182	273	273	273	312	299
Roads, Motorways, Railways, Airports	312	312	221	429	377	273
All core subjects	2197	2392	2483	2548	2327	2054
Programme contact hours	3700	3660	4075	3750	3750	3120

In the followed figures there are drawn the contact hours of selected subjects in percentage of total contact hours during the years. As it is clear from the Tab.1, the Civil and Transportation MSc. Programme is divided in last year to six groups, three of them are connected with Civil Engineering Structures, another three with Transport and Traffic Engineering. We compared only the number of contact hours in common programmes.

In Figure 1 the sharing of some theoretical subjects as Mathematics, Physics, Drawing Geometry, Structural Mechanics and Mechanics of Materials is presented. As it is clear from the diagrams, some small differences occur in percentage of the chosen subjects during the years, when Mathematics varies from 7,4% to 12,1%, Physics from 2,5% to 3,6%, Drawing Geometry from 1,4% to 3,5%, Structural Mechanics from 9,2% to 12,5% and Mechanics of Materials from 1,4% to 5,0%.

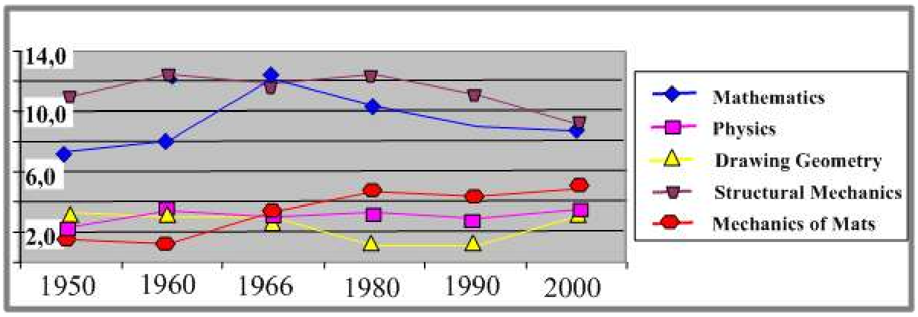

Figure 1 Share of some theoretical subjects on Civil Engineering Programmes
(in percentage of the total number of contact hours)

Likewise in Figure 2 the sharing of some core civil engineering subjects as Concrete Structures & Bridges, Steel and Timber Structures & Bridges, Foundation & Underground Structures, and Roads, Motorways, Railways & Airports is presented. As it is clear from the diagrams some small differences occur in percentage of the chosen subjects during the years, when Concrete Structures & Bridges varies from 6,6% to 10,7%, Steel and Timber Structures & Bridges from 6,7% to 10,2%, diagrams some small differences occur in percentage of the chosen subjects during the years, when Concrete Structures & Bridges varies from 6,6% to 10,7%, Steel and Timber Structures & Bridges from 6,7% to 10,2%, Foundation & Underground Structures from 4,9% to 9,6%, and Roads, Motorways, Railways & Airports from 5,4% to 11,4%.

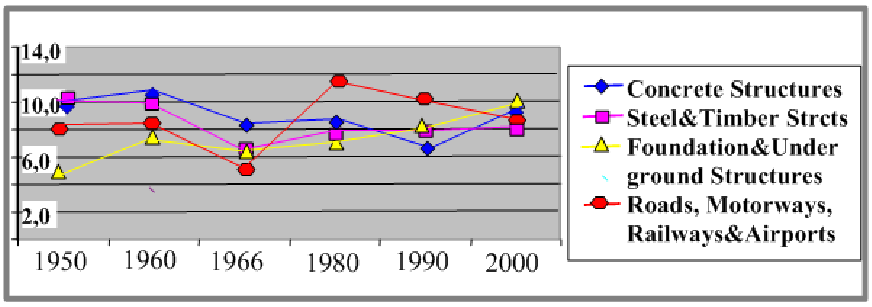

Figure 2 Share of some core Civil Engineering Subjects
(in percentage of the total number of contact hours)

4. TRENDS IN TEACHING METHODS OF STRUCTURAL ENGINEERING SUBJECTS

The number of contact hours of different subjects and their mutual balance is one of the factors influencing the educational process. As we could see from the previous paragraph, the numbers of chosen core subjects at our faculty during the last 50 years have not changed very rapidly.

Another, in author´s opinion more important factor is the balance of the syllabi of different subjects. Present time is known of the huge developing of all areas of the human activities, mainly in natural and technical sciences. In the last decades there were developed new materials and technologies also in civil engineering branch. They play together with the huge developing of the computers and new numerical methods and technique and computer programmes an important role in automation in design of buildings and structures as well as during the building process, what lays some increased claims to the changes of the syllabi.

In process of finding the new directions of the next development of syllabi and teaching methods specially in nature and technical sciences two following aspects play an important role:

- the decision, which parts from the big amount of the theoretical knowledge may be used and which can be neglected when changing the content of the lectures, because of the constant or decreased number of contact hours,
- methods and ways of teaching the topic theoretical knowledge and practical procedures connected with using the new materials and technologies.

If the balance between above mentioned aspects is taken into account by the innovation of the content of subjects, the education of civil engineers will be permanently on a high level. Let us present the authors´ experience with the content of subject Structural Mechanics. During the centuries, but mainly in last decades, the theoretical knowledge and practical procedures used in the static and dynamic analysis of structures rose very rapidly. It influenced the increase of the content of mentioned subject. Student in past had to learn practically by hard the methods of calculation of inner forces acting in many different types of structural elements, statically determined or undetermined, loaded by the constant or moving, static or dynamic, load. The crucial point of the subject was beside the theoretical explanation of the problems focused mainly in teaching the procedures of the "manual" calculations because of missing the computer technique. Student was loaded by a big amount of the manual calculation and it was practically impossible to ask him doing more than one alternative during the process of the design of structures. The design processes were based mainly on the engineering intuition and previous experiences.

Nowadays this process has rapidly changed. The huge developing and using of computers as well as the modern effective numerical methods caused the existence of many packets of computer programmes, which are able to calculate and draw the distribution of inner forces in structures and finally design the necessary dimensions of their elements without the help of the users. It may inspire an impression (and there are many students having it) that it is not necessary to explain the students, future users of these computer programmes, the theoretical background and confine only to the teaching the manuals and practical using of the programmes, but the true is opposite. Because of many existing computer programmes, which take into account the different assumptions of the model of structure, just the engineer must be this creative subject, who will decide the different aspects and components of the analysed model. Thanks to the computers programmes and technique the structural analysis takes only a little time and the saved time may be used for the creative education, e.g. teaching students to create and to compare different models, the perfect controlling of the results and so on. These changes bring a huge amount of the work for teachers because sometimes it is necessary to change the teaching methods from the ground.

5. CONCLUSIONS

An important component, which was not mentioned in this paper is the process of the gradual harmonisation of the civil engineering programmes at particular universities in Europe. Author takes part in an international project EUCEET (European Civil Engineering Education and Training), which deals with these problems. The most positive result of this project is that the teachers from many Civil Engineering Faculties from almost all European countries found the common platform for the mapping of civil engineering programmes. The collected big amount of the facts as well as the group of people working in this project should create a good base for some next projects in this area. One of the possible way could by an attempt to create some common Civil Engineering Programme in European area and define the general conditions for “Euro” Civil Engineering Programme.

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REFORMATION OF CIVIL ENGINEERING EDUCATION IN TALLINN TECHNICAL UNIVERSITY

Toomas Laur[1]

***ABSTRACT**: In Estonian higher education system civil engineers are prepared at the Faculty of Civil Engineering of Tallinn Technical University. Over the period of the University's evolution from Special Engineering Courses to Technical College then Technical Institute and finally Technical University - civil engineering has been one of earliest fields pursued. Despite a certain degree of conservatism characteristic of universities, both advancements in technology and changes in Estonia's political and economic life have had a profound effect on the system and level of engineering education. Another reform of university education is under way, having in aim the restoration of specialist training at an adequate level, based on integral academic engineering education. At the same time, in compliance with the Bologna Declaration, student mobility and integration of Estonian educational system into the European system of engineering education is ensured.*

1. INTRODUCTION

Tallinn Technical University is a major provider of specialist university education in Estonia. In 1918, the Special Engineering Courses of the Estonian Engineering Society started, with 25 person in teaching staff and 120 students, including 33 in the field of civil engineering and architecture. In 1920, the Courses became a state institution - Tallinn College, which was recognized as a higher educational institution in 1923.

In 1936 the foundation of Tallinn Technical Institute was announced by the Decree of the President of Estonia. Two years later it was renamed to Tallinn Technical University.

After the Second World War, the University became Tallinn Polytechnical Institute. After regaining Estonia's independence in 1991, the name of Tallinn Technical University was restored.

Currently, Tallinn Technical University offers programmes in eight faculties: civil engineering, humanities, information technology, chemistry, mathematics and physics, mechanical engineering and systems engineering.

Study domains are organized into the following ten fields:

1. Chemistry and Materials Technology
2. Civil Engineering
3. Economics and Business Administration
4. Engineering Physics
5. Geotechnology
6. Information Technology

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7. Logistics
8. Mechanical Engineering
9. Public Administration
10. Power Engineering.

Civil Engineering, one of the earliest fields, has been one of the most popular programmes offered at Tallinn Technical University.

Five departments, organized into 18 chairs, conduct academic, research and development work (Fig. 1).

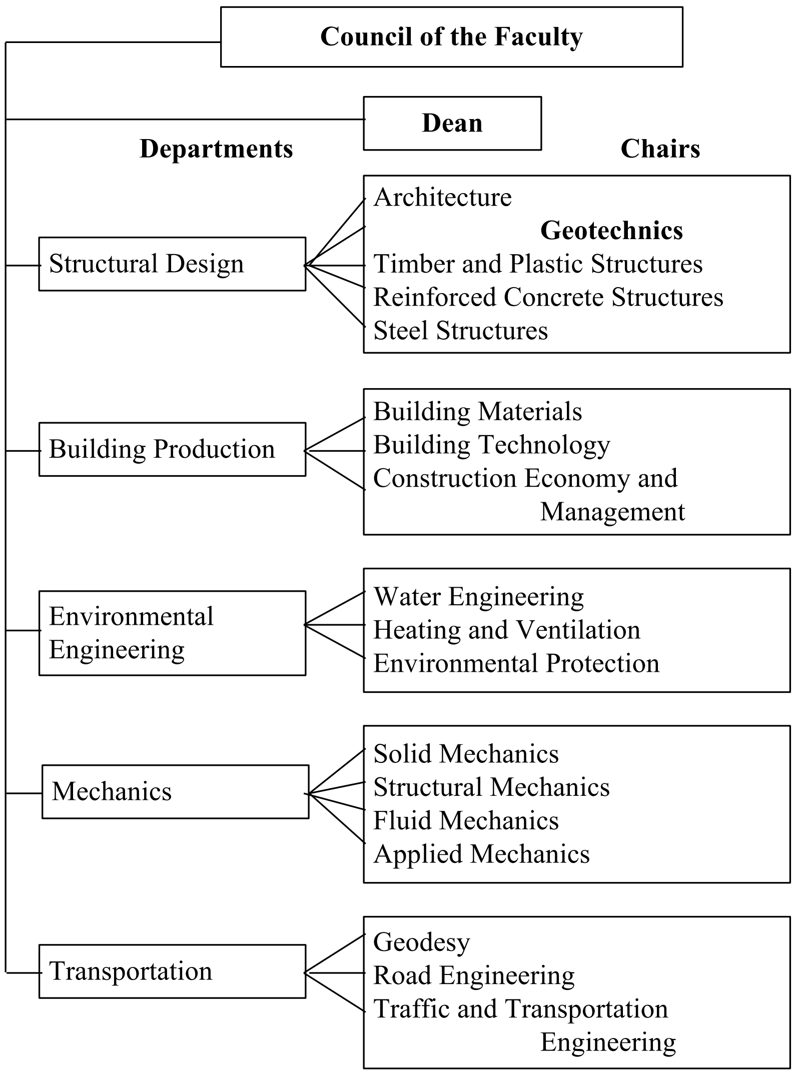

Figure 1 Structure of the Faculty of Civil Engineering

Over the years, based on different instructional systems, the Faculty of Civil Engineering has output of 150 diploma architects, 5649 diploma engineers, 42 bachelor degree holders. The systems of academic qualification implemented after 1944 are shown in Fig. 2.

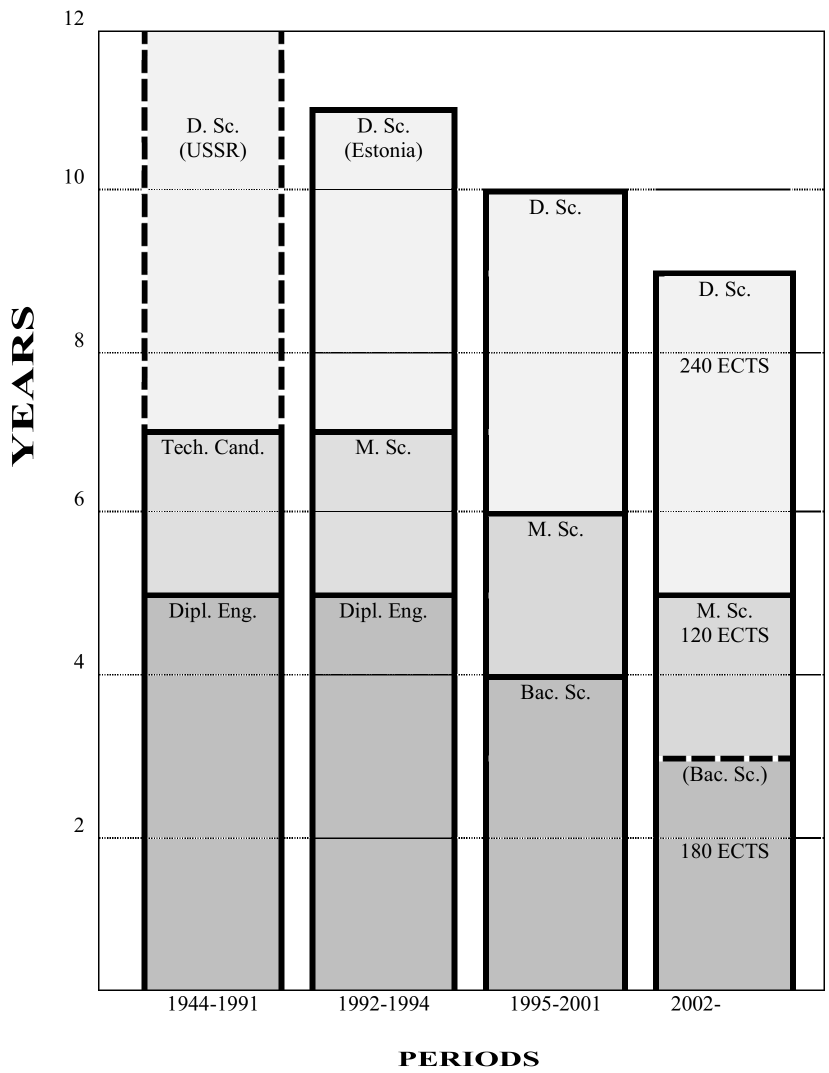

Figure 2 Systems of academic qualification

2. CIVIL ENGINEERING EDUCATION BEFORE THE SECOND WORLD WAR

Before the Second World War, primarily civil engineers in the fields of structural engineering, road construction, and hydroengineering structures were trained. However, in the early period, architects and specialists in geodesy were prepared.

By the end of the 1930s, the curriculum of the domain of structural engineering has been developed. Of the total capacity of 2340 contact hours nearly 60% were lectures, the rest covered practical and laboratory work.

Proportionately, independent work was capacious, the real capacity accounting for 800-900 hours per academic year. A six-week building practice was a precondition of starting the graduation work.

As a result of hard learning conditions and high programme requirements, engineers' output was fairly small in the period before the Second World War. Another problem lay in scarcity of employment opportunities available congruent to an engineer's qualification. At the same time, opportunities of acquiring an engineer's qualifications offered by other European Universities were made use of.

During the period, diplomas in the fields of civil engineering were granted as follows:

- In 1924, 36 diplomas of a technician in the fields of construction engineering, architecture and hydroengineering
- In 1936-44, 60 diplomas in the field of industrial and civil engineering.

3. ORGANIZATION OF STUDIES DURING THE SOVIET OCCUPATION

After Estonia's occupation in 1940, a profound transformation of the system of education and curricula, complying with the Soviet system started. In fact, implementation of the system began in the autumn of 1944 after the battlefield retreated.

Since building companies needed also graduate engineers in addition to employments in design and project organizations, new courses of building production, building machines and organization of construction works were introduced.

A new group of so-called political courses, such as History of the Communist Party of the Soviet Union, scientific communism, political economy, etc., were set up. A system based on a semester organization of studies was established, implying full completion of curricular requirements at the end of each semester.

Along with advancements in construction engineering, particularly in computer technology, curricula were updated.

By the end of the 1980s, studies were organized according to the following system:

- a semester-based organization, amounting to 5 years and 2 semesters within an academic year
- a semester covered 14-17 weeks, with 35-38 contact hours weekly, totalling at approximately 5200 hrs
- 12 course projects, 12 weeks of study and industrial practice (geodesy, building machines and construction industry, a worker's practice, a foreman's practice, pre-diploma practice)

- upon completion of the curriculum, the qualification of a diploma engineer was granted, and an opportunity to pursue a two-year post-graduate course leading to the degree of Candidate of Technical Sciences was available. The doctoral study period, commonly combined with full-time employment, extended to 5-6 years (frequently substantially exceeding it). Both of the degrees were granted by the USSR Council of Academic Awards in Moscow.

Diploma civil engineers were prepared, based on five different curricula:

1. Industrial and civil engineering
2. Production of building elements and structures
3. Water supply and sewage
4. Heat and gas supply and ventilation
5. Road and bridge construction

Distribution of graduate workplaces was decided according to a state employments plan. Thus, a graduate had to take up a workplace prescribed by the plan. Most graduate appointments were in Estonia, however, particularly before the 1980s, building companies, design and research institutes throughout the Soviet Union were frequent workplace locations.

4. ACADEMIC ACTIVITIES IN INDEPENDENT ESTONIA

In 1992 when Estonia regained its independence, work on a new Law on Universities and the Standard of Higher Education started.

Prior to adoption of these documents, the University embarked on reviewing the curricula. First of all, it resulted in excluding the so-called political disciplines and increasing the required courses of engineering.

The capacity of the curriculum (approx. 300 ECTS) was sufficient, enabling flexible and specialized preparation of civil engineers. Thus, students in the field of construction engineering were offered five branches of specialization (45 ECTS):

1. structural design
2. architectural design
3. construction economy and management
4. real estate administration
5. production of building materials

Because Estonia is a small country and only one university-based faculty of civil engineering exists, the curriculum was both technically and organizationally optimal to prepare civil engineers.

However, the University as a whole faced more serious problems concerning resources. In fact, too many specializations led to relatively small learning groups, which was not economically reasonable. Though, it was the University's rather than the Faculty's problem. Civil engineering has always been an attractive field in Estonia and at the Faculty of Civil Engineering there were no problems related to new student recruitment.

In 1995, based on the new Law on Universities and the Standard of Higher Education, a profound reform aimed at University's structure and academic work was conducted. However, in the course of the reform, opposition was raised by all engineering faculties and by several professional associations.

In accordance with the Law on Universities adopted by the *Riigikogu* (Parliament), a transfer to a bachelor-master-doctoral curricula system with a nominal duration of studies 4+2+4 years was established. Instead of a qualification of an engineer, a bachelor programme graduate was granted a bachelor of science degree.

As compared to the first stage of the educational level in the previous period, the following drastic changes took place:

- the duration of studies was reduced from 5 to 4 years
- the number of contact hours was decreased by approximately 35% (primarily involving specialist courses)
- the number of course projects was reduced from 12 to 5
- the total length of practice was reduced twice (from 12 weeks to 6 weeks), practice in building machines and industry was eliminated

Rapid social and economic transformations have caused problems that force the majority of bachelor programme graduates to take up a career. Moreover, many undergraduate students combine their work requiring lower qualification with their studies.

It is obvious that the bachelor programme, which provides a relatively weak specialized training, does not ensure sufficient preparation for independent work in a certain profession (e.g., in project design, project management, etc.).

Both the engineering faculties of the University and the employers have been seeking to change the inadequate system of studies. Owing to similar problems encountered in many European countries, as well as to the expected intensive integration processes guided primarily by the Bologna Declaration, improvements in Estonia's higher education system are anticipated.

Unfortunately, the reforms of university education system have been launched before adoption of the relevant legislation by the *Riigikogu* (Parliament).

At Tallinn Technical University, reformation of the curricula and study system started last autumn and the transfer to the new system is planned in 2002/2003.

Basic principles of the new system in engineering education at the Faculty of Civil Engineering are as follows-

- the bachelor and master curriculum composes a common uninterrupted engineering curriculum, covering 5 years, with a total capacity of 300 ECTS, at the same time, completion of the bachelor level study is recognizable, with different choices available upon completion
- the bachelor level programme is 3 years (180 ECTS), master level - 2 years (120 ECTS)
- the five-year programme is finalized by the submission of a master thesis or engineering project, bachelor studies are conditionally regarded as completed upon 180 ECTS, a graduation thesis is not a requirement (in non-engineering fields, completion of the bachelor and master level studies can be properly recognized, whereas training can be based on different curricula
- specializations are possible in master studies, for instance, in the field of structural engineering, two specializations are offered: construction engineering and construction management and economics

- the engineering curriculum contains the following parts:

		ECTS	
		Limits by the University	In the field of structural engineering
1	general and basic studies	80 - 110	85
2	core studies	60 – 90	80
3	special studies	50 – 90	86
4	optional studies	12 – 18	12
5	practice	5 – 10	7
6	graduation thesis	30 – 40	30

5. CONCLUSIONS

The new study system provides the following:

- restoration of engineering specialist training, acceptable to most employers;
- better preconditions for integration into the European system of higher education;
- opportunities for student mobility - access to learning opportunities and relevant services;
- preconditions for recognition of qualifications based on the Diploma Supplement.

TOWARDS A EUROPEAN CIVIL ENGINEERING QUALIFICATION: REFLECTIONS ON THE SORBONNE AND BOLOGNA DECLARATIONS

Benjamín Suárez Arroyo[1]

ABSTRACT: *Globalisation and the processes of European integration and convergence affect not only the economy and other aspects related to it, but also higher education. The situation of higher technical education in Europe is complex and any process of globalisation, integration and convergence will require a considerable effort and willingness on the part of the European community and countries represented both at institutional and political levels and at social, university and professional levels. For these reasons, this article analyses the latest European trends on this issue and proposes to adapt the structure and overall organisation of civil engineering education in Spain from a perspective that allows the different needs and realities of Spanish universities and professionals to be considered harmoniously and untraumatically.*

1. REFLECTIONS ON CIVIL ENGINEERING EDUCATION

Civil engineering first appeared as the alternative or response of civil society to needs that had hitherto been satisfied by military engineering. The strategic and military interest in infrastructure, roads, ports, fortifications, etc., was transformed into a social interest with the result that civil society planned and developed an alternative response. Ministries of Public Works appeared in order to promote and manage activities in this field, and alongside these teaching centres of civil engineering dependent on such Ministries.

These civil education centres followed the guidelines established by their military counterparts, which often appeared under the denomination of Academy or Institute of Mathematics, names that provided a clear reference to the type of education offered in them. Construction and basic sciences were very closely related to these, and for this reason both military engineering and its direct descendent, civil engineering, have always included intense training in physical mathematics in the wider sense.

In 1747 the first school of civil engineering, *l'Ecole National des Ponts et Chaussées,* was founded in Paris, an initiative that was not followed up until 1802 in Madrid with the founding of the *Escuela de Caminos, Canales y Puertos* and subsequently in London with *Imperial College*. The idea gradually spread across the remaining European monarchies and to Latin America. All of them offered education from a similar perspective, in such a way that algebra, differential equations, calculus, physics and geometry were common disciplines and considered fundamental to obtaining the necessary skills in the science of construction.

The process has spread and expanded in such a way that the number of civil engineering schools, forming part of different university systems, in Europe today is large and varied (in Spain there are 9 Civil Engineering Schools and 12 Public Works

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qualifications). Because of this and in spite of the fact that the general philosophy of the content of the teaching remains the same, the programming and methodologies, intensity, quality and available resources, social reality and other variables intervening in the education process are so diverse that in many cases civil engineers have little in common with each other.

In a European context, this situation is not a desirable one, as such diversity reduces or restricts the mobility of not only students and faculty, but also civil engineers within the European community since, independent of criteria of a more professional or community-based nature, both partial studies and the corresponding qualification are only recognised in the country of origin in the majority of cases.

In an increasingly globalised world, and particularly in the European community, with its comprehensive process of integration and convergence in operation, it seems unreasonable that this situation should exist at the dawn of the 21st century. However, the situation is a complex one and the solution will require willingness and effort on the part of the European Community and the countries that form part of it on both an institutional and political level, and on a social, university and professional one.

This situation not only affects civil engineering, but all European higher education. Conscious of this, over the last decade the European Union has developed Transnational Education Programmes, such as COMETT, ERASMUS, SOCRATES, LEONARDO, etc., promoting mobility, exchanges of students and faculty and the creation of mechanisms to recognise credits (the ECTS scheme) between European universities. Such initiatives have been warmly welcomed by society and the European university community and have resulted in the existence of a certain culture of movement that has resulted in a considerable number of European students and faculty undertaking educational placements outside of their countries of origin.

However, these measures have had very little impact on the overall structure and organisation of higher education in Europe, which continues to maintain independent education systems in each country that give higher priority to national or traditional interests than to adapting higher education to the needs of the new transnational social reality demanded by the new millennium.

2. REFLECTIONS ON THE DECLARATIONS OF THE SORBONNE AND BOLOGNA

Perhaps because of the above, in recent years two interesting proposals have arisen that may determine the short-term future of the evolution of higher education in the European Union.

The Sorbonne declaration, *Joint declaration on harmonisation of the architecture of the European higher education system*, made by the education ministers from four major European countries, namely France, Germany, Italy and the United Kingdom, in Paris on 25 May 1998, clearly and unequivocally states that the European Union must not only deal with the legitimate economic and financial objectives of Europe, but also build a Europe of Knowledge in a wider sense, in other words jointly consider all of its intellectual, cultural, social and technical dimensions. The manifesto ends by calling upon all member states and universities of the Union and other European countries to make a combined effort in order to create a European Higher Education Area which, without detriment to national identities and interests, will be able to consolidate the position of Europe in the world through the continual improvement and modernisation of the education of its citizens.

The Bologna declaration, *The European Higher Education Area*, signed by the education ministers from 29 European countries (including Spain) in Bologna on 19 June 1999, picks up on the philosophical ideas of the Sorbonne declaration and proposes more concrete measures in order to achieve them. The signatories manifested a clear intention to create a European Higher Education Area clearly within the context of its powers and which fully respects the diversity of cultures, languages, and systems of national education and university autonomy, hoping that European universities will respond quickly and positively to its call by actively contributing to the success of its initiative.

The principal courses of action proposed in the Sorbonne and Bologna declarations may be grouped into the following points:

- To adopt a system of qualifications that is understandable and comparable in order to promote employment opportunities and the international competitiveness of European higher education systems.
- To adopt a system of qualifications based on two principle cycles. The first cycle qualification will be in accordance with the European employment market and will offer an appropriate level of qualification. The second cycle, which will require the first to have been passed, should lead to a form of Master's degree.
- To establish a system of credits as the most appropriate means of creating extensive student mobility.
- To promote mobility with particular attention to student access to European studies and the different education opportunities and related services. Recognition and appraisal of placements in various countries of teaching staff, researchers and administrative teams without prejudice to their legal rights.
- To promote European cooperation in order to guarantee quality and develop comparable criteria and education methodologies.
- To promote the necessary European aspects in higher education studies, in particular curricular development, institutional cooperation, mobility schemes and integrated programmes of study, education and research.

Without doubt, both declarations are of an impeccable nature and deal with all of the fundamental structural aspects required for the convergence of European higher education. This is not just a personal evaluation, but one shared by public figures of unquestionable importance in the field of higher education in Spain, such as Dr. Bricall, former Rector of the University of Barcelona and former Chairman of the European Rectors Conference, expressed in his report Universidad 2000, in which his section on the transfer of knowledge proposes actions such as:

- Increased involvement of students in their learning process (a capacity to choose educational paths).
- Universities must organise their studies with greater flexibility, a structure that favours inter-disciplinarity at initial levels and specialisation at more advanced levels, international transportability, cyclicity and continuing education.
- Administrations must ensure sufficient levels of resources, guaranteeing quality and transparency in the process.

And all of the above adopting the guidelines established by the declaration of Bologna.

Is it possible for higher education in Spain to adopt the proposals of the Sorbonne and Bologna declarations, thus bringing about convergence in European higher education? The Universidad 2000 report would lead one to think so and, even if some of its proposals may be criticised and clearly improved upon, there is no doubt that it constitutes an excellent starting point for a debate on how to achieve the proposed convergence objectives.

Is it possible for technical university education and in particular that relating to civil engineering in Spain and Europe to implement the Sorbonne and Bologna proposals? In line with the more general reasoning above, the response should be an affirmative one, although perhaps the transformation required may be more necessary and profound in the case of engineering than for other qualifications.

Furthermore, the process of adaptation necessary in order to achieve the convergence objectives may also provide an opportunity, perhaps the last opportunity, to undertake a detailed review of structure, methodology and content, in order to seek a balance between education that provides a response to social demand, to what the construction employment market needs and what is most desirable to society as a whole, which do not always coincide.

3. EUROPEAN CIVIL ENGINEERING: A PROPOSAL FOR THE ORGANISATION OF THE EDUCATION PROCESS

The process of syllabus reform undertaken over the last decade in Spain has generated a dynamic that is enriching both from an organisational and structural perspective, as well as one of content and methodology; however, it remains unfinished, given that in the Schools of Civil Engineering and Public Works, reformed syllabuses (5 and 3 years) and unreformed syllabuses (6 and 3 years) continue to co-exist.

What is more, the current general directives of the Degree in Civil Engineering and the Diploma in Public Works coincide 80% in their core subjects, with the result that the ultimate educational objectives of the two qualifications are very similar, in spite of having a different level of intensity. The possible recognition of the Diploma in Public Works as belonging to Group A in the context of the European civil service, together with the historical demand of those involved in the teaching of the diploma to extend the period of study to four years may further accentuate this, thus narrowing the gap between these two century-old qualifications of widespread social impact.

In this context, and in order to further analyse this issue and its repercussions, I think it would be appropriate to make an effort and consider a new structure, a new organisation for civil engineering studies that adapts itself to the convergence agreements and criteria for European higher education mentioned above, but one that also allows the different needs and realities of Spanish universities and professionals to be considered harmoniously and untraumatically.

As a product of this process of reflection, Figure 1 presents a draft organisation proposal; although this may appear complex at first sight, it is no more than the result of considering, ordering and integrating the most significant elements of the process, respecting the current academic and professional reality, but with a sufficient degree of freedom for it to be accepted by all the groups involved and developed if considered necessary.

Basically, Figure 1 considers the following curricular paths:

Academic Path, with three phases: Diploma, Master's and Doctorate

First phase:	Diploma. Basic qualification of 3 years
Second phase:	Master's Degree of 2 years
Third phase:	Doctorate of 3 years

In accordance with the Bologna diagram and consequently defining a **European Higher Education Area**.

Professional Path, with two levels: *Civil Engineering and Advanced Civil Engineering*

1st Level:	The basic grade plus a professional complement of 1 year defines the Professional Civil Engineer.
2nd Level:	The basic grade and master's plus a professional complement of 1 year defines the Advanced Professional Civil Engineer.

The first level should provide the European employment market with a specialist technician. The second level should provide the European employment market with a technician with an overview of civil engineering.

Both levels would define the **European Professional Accreditation Area**.

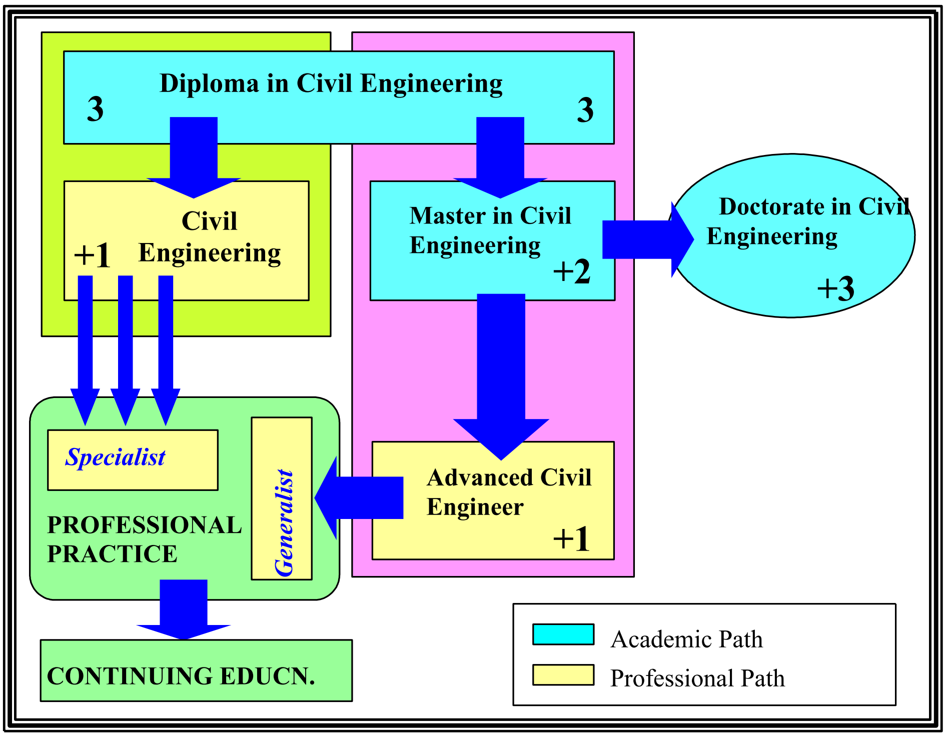

Figure 1 Overview of the structure of civil engineering education

An initial proposal with regard to content could be as follows (Figure 2).

The basic grade should deal with the foundations of basic sciences (mathematics, physics, etc.), applied sciences and techniques (mechanics of materials, solids, fluids, etc.) and applied technologies.

The Professional Specialisation phase should offer intensive education in one of the specialist areas of civil engineering, either traditional (Hydraulics, Transports, etc.) or new depending on the needs of society or enterprise and the Final Thesis.

The Specialisation of Knowledge phase should provide detailed analysis of certain aspects relating to basic sciences and applied technical sciences.

The Advanced Technological Education phase should provide detailed analysis of the technologies involved in Civil Engineering, while introducing aspects relating to planning, design, construction, management and operation.

The Professionalisation of Knowledge phase should provide detailed analysis of aspects relating to the planning, design, construction, management and operation of civil infrastructure and the Final Thesis.

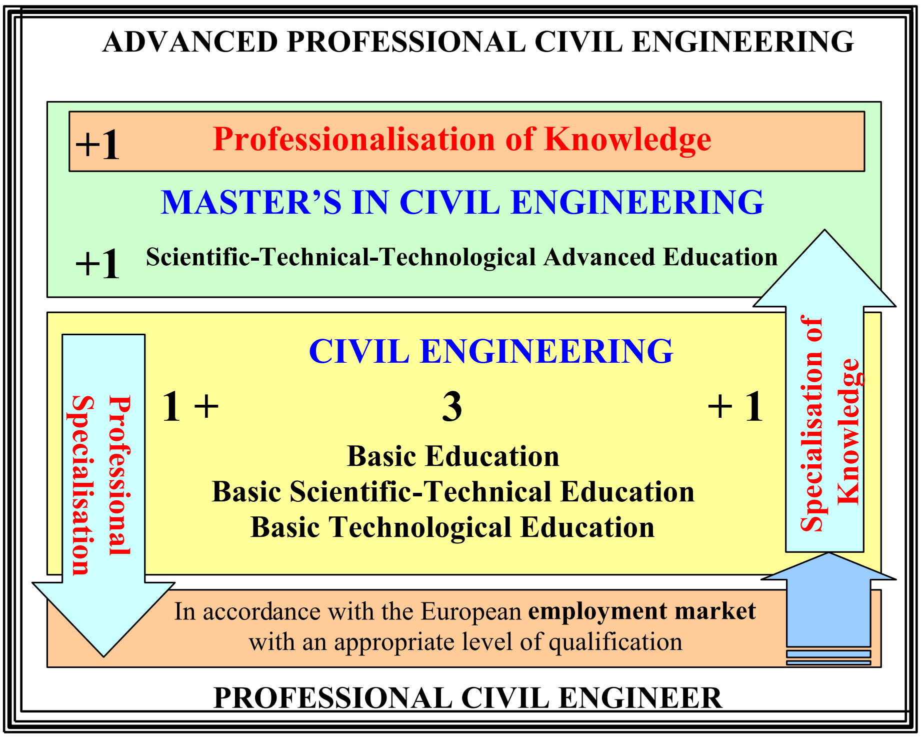

Figure 2 Education processes involved in the proposed model

The model attempts to generate a system of qualifications that is understandable and comparable, in order to promote employment opportunities and the international competitiveness of European higher education systems by establishing academic cyclicity and certain mechanisms of professional accreditation, but without producing a hierarchy or causing perverse effects to professional qualifications that can result from such mechanisms (a professional master's degree without accreditation could play such a role). In the proposed professional qualifications, subsequent continuing education could play a much more important role than at present.

In the model, the education phases that deal with knowledge in the wider sense (Diploma and Master's) and those with a special adaptation to the employment market (Professional Specialisation and Professionalisation of Knowledge) are clearly differentiated. In this respect, the model only partially satisfies the proposals of the Bologna declaration, but on the other hand indirectly establishes a mechanism (with a structure that is academic and therefore objectifiable, educational and of demonstrable quality) of European unification or convergence for professional accreditation.

The philosophy of the model is that responsibility and the commitments of higher education in society, with its citizens and social demand, will be fulfilled with the qualification of Professional Civil Engineering. The configuration of an intellectual and professional elite that is advanced in the wider sense and in terms of research will be provided by the Master's and Doctorate in Civil Engineering. In order to achieve this, a key element in the model is the education process called Specialisation of Knowledge; this must be selective and along the lines of the Italian university reform, so that only the best curriculums (how many and by what means?) have access to this. This selection process will need to be the object of debate and subsequent detailed analysis if the idea proves to be of interest.

4. SOME FINAL CONSIDERATIONS

The model presented can easily be applied to all engineering and architecture qualifications, by considering and integrating in each case the various formats that exist in Europe, with simple alternative transitions, by simply adapting the names of the different qualifications proposed to each particular case.

Other qualifications that are unrelated to engineering, but of significant professional importance, e.g. Law, Teacher Training, Economics, etc., may also be incorporated into this structure.

The more scientific qualifications, and/or those with little or negligible professional significance, may also be considered in the proposed model by means of the academic educational path by simply deactivating the education processes related to professional practice. In this case, the diploma establishes an equivalent level of academic qualification for European higher education, facilitating and promoting mobility by means of the Master's and the Doctorate.

It is evident that the model must also incorporate important academic challenges relating to content, methodologies, etc., in order to achieve a balance between scientific, technical and applied education, society's demands and European convergence. In this phase, I believe that learning must be the most important challenge and that education must take priority over information, which will undoubtedly stimulate the habit of studying and consequently continuing education. Incentives should also be offered for skills that promote teamwork, initiative and management ability, without endangering the freshness and enthusiasm necessary to meet the challenge of a highly competitive professional activity and all of this at a reasonable personal, social and institutional cost.

As university reform begins to take shape, I believe that European university student and professional groups should be constructive and offer a contemporary perspective in relation to higher education in Europe that takes into account the new proposals, facilities and considerations that European society is now demanding for the 21st century.

CHALLENGES TO THE CIVIL ENGINEERING EDUCATION IN SPAIN

S. Olivella, Joan R. Casas, M. Espino & M. Gómez[1]

ABSTRACT*: Two types of Civil Engineer exist in Spain. The Ingeniero de Caminos, Canales y Puertos requires 5 courses of preparation and the main professional activity is devoted to lead big civil engineering works. The Ingeniero Técnico de Obras Públicas requires 3 courses of preparation and the main professional activity is devoted to more technical issues than the former Engineer. Geological engineer is also a graduation, which is shared between the Civil Engineering School of Barcelona and the Faculty of Geology. Different models for new types of graduation are presented also in this paper.*

1. INTRODUCTION

At the Escola Tècnica Superior d'Enginyers de Camins, Canals i Ports of Barcelona it is possible to graduate in three different ways:

Spanish Name	English Name	Duration	Name
Ingeniero de Caminos, Canales y Puertos	Civil Engineer 1st and 2on cycle. Literally: Road, channel and port Engineer	5 years	ICCP
Ingeniero Tècnico de Obras Publicas	Civil Engineer 1st cycle. Literally: Public Works Technical Engineer.	3 years	ITOP
Ingeniero Geólogo	Geology Engineer 1st and 2on cycle	5 years	IG

A lot of graduates in ICCP work for building companies and usually they lead important construction projects. They are in charge of both technical and financial aspects. Other graduates work for consulting companies developing projects or as public servants in the government ministry. In general, the first 2-3 years after graduation, the Engineer assists an experienced engineer but soon is left alone to manage big projects. In terms of formation, a ICCP spends 2 years in basic subjects (mathematics and physics) and latter he/she studies more technical courses.

Graduates in ITOP normally should work together with an ICCP. The original concept of the ITOP was to assist. At present the professional activity of the ITOP is related to more technical issues than the ICCP. This later, normally tends to become a manager of big construction works. In terms of formation, an ITOP spends 1 year in basic subjects and latter he/she studies more technical courses. Mathematics and physics have an applied orientation in this graduation.

One way to define a graduated in IG is half civil engineer and half geologist. Since this is a relatively young graduation in Spain, the professional activity is not very well defined. In general, they are involved in geothecnical activity both in building companies or consulting companies. Formation is shared between the civil engineering school and the faculty of geology.

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Adaptation of the present situation to the European approach defined in The Bologna Declaration signed by the Ministers of Education of 29 European countries on the occasion of the CRE/Confederation of EU Rectors' Conference, held in Bologna on June 18-19, 1999 is a challenging objective of the Escuela Tecnica Superior d'Enginyers de Camins, Canals i Ports of Barcelona.

2. CIVIL ENGINEER CURRICULUM AT THE BARCELONA SCHOOL

The present curriculum is Civil Engineer is based on a Royal Decret published in the BOE (State Official Bulletin) in october 1991. This regulation defines the *Ingeniero de Caminos, Canales y Puertos,* the *Ingeniero Técnico de Obras Públicas* and the general guidelines for the development of the studies.

The ETSECCP prepared proposals that, due to different regulations, have the following features (Table 1 is a comparison between the different types of graduation):

- *Materias* (subjects) are classified in four categories.

  Materias troncales (core subjects): These are common for the students and are the same in all Civil Engineering Schools in Spain. The names, the credits and the knowledge areas are defined by law (Real Decreto 1425/1987).

  Materias obligatorias de universidad (subjects compulsory for a given university): These are common for the students in the same university but change from one university to the other university.

  Materias optativas (optional subjects): These are subjects optional for the students. They choose some of them in order to cover a minimum number of credits.

  Materias de libre elección (free election subjects, ALE: accronim of the spanish name: asignatura de libre elección): These are also optional subjects for the students and they must cover a minimum number of credits.

  These may have to do with topics non directly related to civil engineering (art, humanistic, for example)

  Depending on the contents, the classification of subjects is: Basic, Technological-Basic and Technological.
- Graduation is accomplished in 4 (minimum) or 5 (maximum) courses[2] in the case of *Ingeniero de Caminos, Canales y Puertos*, and 3 (minimum) or 4 (maximum) courses in the case of *Ingeniero Técnico de Obras Públicas.*
- Two cycles must be defined in the first case and one in the second case. Each cycle is composed by 2 courses, at least. In the case of *Ingeniero de Caminos, Canales y Puertos* the 2 + 3 option was chosen by the school of Civil Engineering of Barcelona and in the case of *Ingeniero Técnico de Obras Públicas* the 3 courses option was chosen. If an *Ingeniero Técnico de Obras Públicas* continues into *Ingeniero de Caminos, Canales y Puertos* the total duration will be 3+3 courses because he/she begins with the 2nd cycle which is composed by 3 courses.
- The amount of classes should fall in the range of 20 to 30 hours/week which is equivalent to 60 to 90 credits/year.

[2] By '*course*', in the context of describing various types of curricula, the authors of the paper understand, obviously, one year of study (Editor's note).

- The maximum amount of credits for graduation is 375 in the case of 5 courses and 225 in the case of 3 courses.
- The number of credits in *Materias troncales (core subjects)* is 180 (90 credits/ cycle).

Table 1 Comparison between the two Civil Engineering Graduations

Graduation name	**Ingeniero de Caminos, Canales y Puertos** Civil Engineer (5 courses)	**Ingeniero Técnico de Obras Públicas** Civil Engineer (3 courses)	**Ingeniero Geólogo** Geology Engineer (5 courses)
Year in which the studies plan was updated	1995	1996	2000
Duration of the studies	5 courses	3 courses	5 courses
Cycles	1st cycle: 2 courses 2nd cycle: 3 courses	1st: 3 courses	1st cycle: 2 courses 2nd cycle: 3 courses
Specialization or intensification	Intensification types: • Construction • Environmental • Hydraulical • Geotechnical • Maritime • Structural • Transportation • Urbanism • Computation	Graduation types: • Construction • Hydraulics • Transportation (These specializations define a different graduation with different professional curriculum).	Intensification types: • Environment and resources • Public works and ground engineering
Distribution of credits: *Materias troncales* *Materias obligatorias* *Materias optativas* *TFC* *ALE*	 216 84 37.5 18 39.5	 112.5 66 22.5 1.5 22.5	 241.5 48 37.5 10.5 37.5
Total credits (*)	395	225	375
Project or Thesis for graduation	Project and Tesina (little Thesis)	Project	Project or tesina (little Thesis)
Evaluation	Continuous and curricular	Continuous and curricular	Continuous and curricular
Selection phase	1st course	1st course	1st course

((*): 1 credit is equivalent to 10 hours of lectures)

- 10% (mínimum) of credits in *Materias de libre elección* (*ALE*), 10% (mínimum) of credits in *Materias Optativas*, 10% (mínimum) of credits for the Project or Graduation Work (*TFC*), 5% (mínimum) of credits obtained outside the university, i.e. professional experience.
- Inclusion of a phase that permits to select the students. The first course should be passed full, i.e. the second course cannot start until all the credits of the first course have been passed. Two years is the maximum time permitted to be spent in the first course. In the case the student does not pass in two years, he/she cannot continue as a student in the school.
- No compulsory credits in foreign languages.

- No compulsory credits in professional internships. The student may get optional cretdits depending on the number of professional activity.
- Continuos evaluation of knowledge. This means that any progressive method should be implemented and this is the opposite of the classical scheme of a single final examination.
- Curricular evaluation, which is intended for a global course evaluation. There is a commission that makes the curricular evaluation. If a subject does not reach the qualification of 5 (which is the minimum to pass) but reaches the qualification of 4 it is considered *compensable* and it can be compensated if all the other subjects in the course have been passed.

2. EXISTING PROPOSALS FOR CIVIL ENGINEER STUDIES IN SPAIN

Several proposals for curriculum adapted to the Bologna declaration have been proposed in Spain. A brief description of them is presented in this section.

Model 1

Benjamin Suarez[1], a professor of the Civil Engineering School of Barcelona (UPC: Universitat Politécnica de Catalunya) proposes 4 types of graduation. These are summarised in Figure 1 and are the following:

Ingeniero Civil Académico ***Academic Civil Engineer***	This is the basic graduation and it takes 3 courses to graduate. It contains basic formation and graduation is not intended for professional activity. After these 3 courses the student may go to the Professional Civil Engineer or to the Master in Civil Engineering.
Ingeniero Civil Profesional ***Professional Civil Engineer***	The duration of this graduation is 3+1=4 courses. This means that the 3 courses of Academic Civil Engineer are complemented by 1 course of Professional Specialisation defined with the advice of the Professional Institutions but the course is taken at the University. Professional Activity can start after this graduation.
Master Académico en Ingeniería Civil ***Master in Civil Engineering***	The total duration of studies to reach the Master is 3+1+1=5 courses, i.e. this is composed by the Academic Civil Engineer plus one Specialisation course and one course of Scientific Formation. All contents are defined in the Academic environment. An alternative graduation with a Master is that the 1+1 courses are added to the Professional Civil Engineer which is composed by 3 courses. In this alternative the total duration is ((3+1)+1+1) = 6. This graduation gives access to the Ph. D. in Civil Engineering and to the Advanced Professional Civil Engineer.
Ingeniero Civil Avanzado Profesional ***Advanced Professional Civil Engineer***	The total duration of this studies is (3+1+1+1) = 6. This graduation is composed by the Master in Civil Engineering and one course of Professionalization of knowledge defined jointly by the University and the Professional Institution. Professionalization in this case would imply to make practical application of knowledge, real simulations of professional activity, case analysis, group work and business administration.

The model proposed by Benjamin Suarez is rather comprehensive and introduces different levels, it condenses the existing types of graduation (2 types rather parallel and independent) and it is modular (3, 4, 5, 6 courses lead to different levels of knowledge).

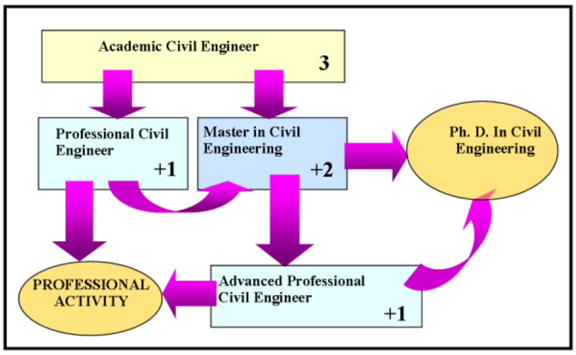

Figure 1 Model proposed by Benjamin Suarez (Professor at the Civil Engineering School of Barcelona, UPC)

Model 2

Federico Bonet[2], a professor of the Civil Engineering School of Valencia (UPV: Universitat Politécnica de Valencia) has proposed the model that is described in Figure 2 and is the following:

A first cycle of three or four years in order to obtain any of the three qualifications as Public Works Technical Engineer (ITOP, defined above) and which subsequently allows the "bachelor" to practice their speciality. It should be indicated that while the three qualifications are different, the labour market does not differentiate among the three and, therefore, it would be better if there were a certain standardization of these qualifications.

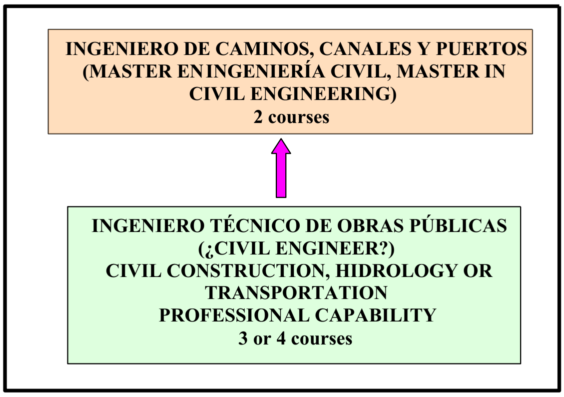

Figure 2 Model proposed by Federico Bonet (Professor at the Civil Engineering School of Valencia, UPV)

A second cycle of two years which covers complementary basic science subjects, company administration and technical subjects which were not studied in the first cycle. At present our second cycle lasts three years, but in reality those students proceeding from the Public Works courses are awarded a number of credits equal to one year in accordance with their speciality.

Model 3

Edelmiro Rua[3], the director of the Civil Engineering School of Madrid (UPM: Universitat Politécnica de Madrid) has proposed the model that is described in Figure 3.

It has the following types of graduation:

Ingeniero Civil Diplomado ***Diplome of Civil Engineer***	This is the basic graduation and it takes 3 courses to graduate. After these 3 courses the student may go to the Civil Engineering graduation.
Ingeniero Civil ***Civil Engineer***	The duration of this graduation is 3+1 = 4 courses. This means that the 3 courses of Diplome of Civil Engineer are complemented by 1 course of Specialisation. Professional Activity can start after this graduation.
Master en Ingeniería Civil ***Master in Civil Engineering***	The total duration of studies to reach the Master is 3+1+2=6 courses, i.e. this is composed by the Diplome of Civil Engineer plus one Specialisation course and two courses of Scientific Formation. This graduation gives access to the Ph. D. in Civil Engineering and to the Professional activity.

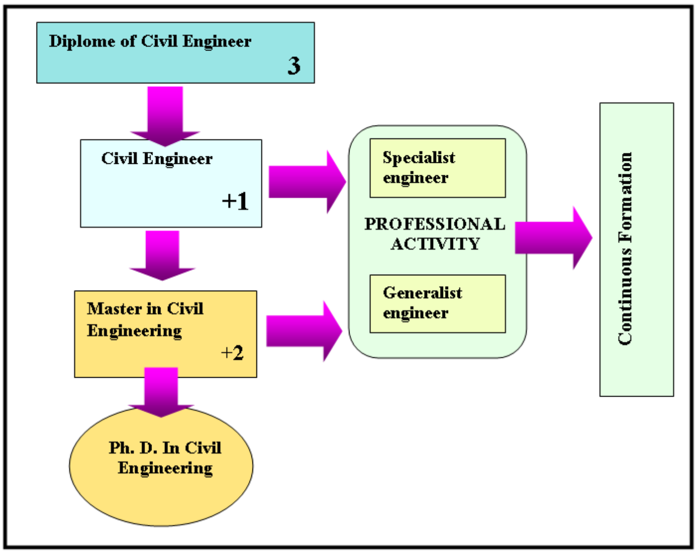

Figure 3 Model proposed by Edelmiro Rua (Director of the Civil Engineering School of Madrid, UPM).

4. CONCLUSIONS

Among the three models presented in this paper, model 2 is completely different. *Model 2* takes advantage of the present situation and tries to effectively connect the existing graduations i.e. the ITOP (3 courses) can be followed by the ICCP (2 additional courses). This means that the duration of 3 and the duration of 3+2 are considered in this model.

Model 1 and *Model 3* propose completely new structures. In the case of *Model 1* the Professional Civil Engineer, the Master Civil Engineer and the Advanced Professional Civil Engineer are possible, respectively with the following duration: 3+1, 3+2 and 3+3 courses. In case of *Model 3* the Civil Engineer and the Master Civil Engineer are considered, respectively with the duration of 3+1 and 3+3 courses.

It is very difficult to extract conclusion about the goodness of the models proposed up to the present. One of the most important difficulties is outside the University because the professional activity of Civil Engineers in Spain is related to two Professional Institutions. For historical reasons the convergence in single curriculum with modularity is difficult but there are also reasons of implementation. If technical subjects are introduced in the 1st and 2nd course, some basic subjects are never recovered. This means that there should be an equilibrium between basin subjects and technological subjects that permit to start professional activity after 3-4 years or continue formation until 5-6 years.

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THE CORE OF CIVIL ENGINEERING KNOWLEDGE – A PREREQUISITE OF EFFECTIVE STUDENTS EXCHANGE BETWEEN EUROPEAN UNIVERSITIES

Stanisław Majewski[1] and Ryszard Kowalczyk[2]

***ABSTRACT**: Exchange of students between higher education institutions in European countries will certainly become an important requirement of effective education in civil engineering. To facilitate this exchange, some steps are proposed, namely: precise definition and recognition of qualifications gained at each educational stage; harmonisation of the general organisation of higher education system in Europe; definition of "core knowledge" for civil engineering education. The analysis of study curricula applied at undergraduate level undertaken within the EUCEET project revealed a huge diversity of subject names (about 390), which creates serious barriers to students' exchange between different universities. To greatly improve this situation, a proposal for unified subject names (38) is made and is submitted to be discussed within the forum offered by the EUCEET Thematic Network.*

1. INTRODUCTION

The international exchange of students between European Higher Education institutions becomes more and more accepted reality. It seems that in forthcoming years it will become one of important requirements of effective education in engineering sciences. No doubt the student's stay in a different university environment abroad itself is very instructive and fruitful personal experience for him/her. Nevertheless, as academic teachers and engineers we should reflect how this stay should be organised to assure the best academic and professional experience as well.

Already for several years the students' exchange within Socrates scheme has been conducted between the Civil Engineering Faculties of the Silesian University of Technology in Gliwice, Poland and University of Beira Interior in Covilha, Portugal. The experience gained during this co-operation proved that some form of similarity of educational systems, study curricula and programs seems to be necessary or at least beneficial for better results. It should be strongly emphasised that we don't think about any form of unification. The autonomy of the University is a great value and no doubt that every university should preserve the individual character of its teaching environment. Yet it is much easier to organise teaching for foreign students and to send own students abroad, if we roughly know what they are going to learn and how does it fit to the programme realised at the home university. Therefore, we propose some steps which should be undertaken to facilitate the European students' exchange. These steps refer to:

- Possibly precise definition and recognition of qualifications gained at particular stages of education.

[1] Silesian University of Technology, Gliwice, Poland
[2] University of Beira Interior, Covilha, Portugal

- General organisation of educational system.
- Definition of "core knowledge" for civil engineering education, which concerns 50-70% of study curricula as well as contents of particular principal subjects. Remaining 30-50% should be individual at each university.

Several years of participation in European educational projects like Tempus and Socrates and particularly the results of EUCEET project determine the basis for these proposals.

2. CIVIL ENGINEERING DEGREES AND CORRESPONDING QUALIFICATIONS

Two professional degrees: Bachelor of Science and Master of Science are recognised all over the world. This is noticed by the Bologna Declaration[3], which recommends "*Adoption of a system of easily readable and comparable degrees, also through the implementation of the Diploma Supplement, in order to promote European citizens' employability and the international competitiveness of the European higher education system*".

There is a discrepancy in the length of the teaching periods particularly for the first degree from 3,5 year to 5 years. (in Portugal it is just 5 years) The period of teaching for the second degree is more or less equal 2 – 2,5 years. The organisation of studies is slightly different: in many countries for both degrees a diploma work or diploma project is required; in other countries, for the first degree there is a final project, but not considered as a diploma work, but as a subject. For second degree MSc usually a master thesis is prepared and defended.

Civil engineering is a very broad area of applications, therefore the studies are usually divided into specialisation in the last years of study. This specialisation may be either narrow or broad. Depending on this are the chances for employment. Anyway, the graduate should be prepared to plan, design, execute and supervise the civil engineering structures taught in the specialisation and have enough background to deepen his/her studies and preparation for other structures, if requested.

In some countries the accreditation of civil engineering studies by the Professional Organisation of Engineers is recommended. That means that the graduates besides their B.Sc. are entitled to use the title of Engineer and start their professional career without any additional certificates and additional exams. These requirements seem to be a good verification of the teaching programs of the Civil engineering Departments by independent professional body.

For the students' exchange lasting at least one semester it is, therefore, necessary that the co-operating Universities are very good acquainted with the programs of partner University and can advise the students to choose the subjects, which are real complementation of their studies in the mother University. We usually cannot count that the subjects taught in other university are covering exactly the same area as in own university, but our teaching staff should be flexible enough to accept the diversities in programs. Without such approach we cannot create a good basis for students' exchange.

[3] Joint declaration of the European Ministers of Education convened in Bologna on the 19th of June 1999

3. STUDY SYSTEM

General organisation of educational systems differs significantly not only in global but also in European scope. Without going into details following systems can be specified:

1. One-stage system - fig. 1a and 1b
2. Two-stage system (three-stage including PhD level) - fig. 1c
3. Branched system - fig. 1d

Each of these systems can be realised in form of pure university teaching as well as so called "sandwich courses", which include 1 or two semesters compulsory Industrial Practical Placement. The duration of studies varies from 3 to 5 years at BSc level and from 4 to 7 years for Master (integrated) courses.

We don't want to evaluate here particular systems, however it should be stated that the Bologna Declaration explicitly recommends the two-stage one[4].

This model is more effective, easily reveals better candidates for higher stages of education thus enabling rising up the teaching level and inclines to logical partition of the teaching material between the basic course (BSc) and higher (MSc, PhD) stages. The branched system is very similar to the pure two-stage one, however its shortcoming is the lack of professionally directed diploma, which is essentially different than the MSc thesis.

There is no doubt that the students exchange is much easier between the universities which have adopted similar educational systems, however it is also possible between those which work in different ones. Yet in both cases possibly exact knowledge about study curricula and the contents of particular subjects is essential.

4. CHARACTERISTICS OF CURRENTLY EXISTING CURRICULA

The detailed analysis of study curricula at the undergraduate level was undertaken within the EUCEET project by working group A. A number of parameters was analysed and the results have been presented in the first EUCEET volume entitled *"Inquiries into European Higher Education in Civil Engineering"*. In this paper we want to draw the attention towards the contents of study curricula, firstly the names of subjects taught. The analysis of curricula sent by 24 universities from 19 countries revealed the huge diversity of subject names. About 390 subjects can be found in these curricula. Currently used subject names are given in table 1.

[4] „Adoption of a system essentially based on two main cycles, undergraduate and graduate. Access to the second cycle shall require successful completion of first cycle studies, lasting a minimum of three years. The degree awarded after the first cycle shall also be relevant to the European labour market as an appropriate level of qualification. The second cycle should lead to the master and/or doctorate degree as in many European countries"

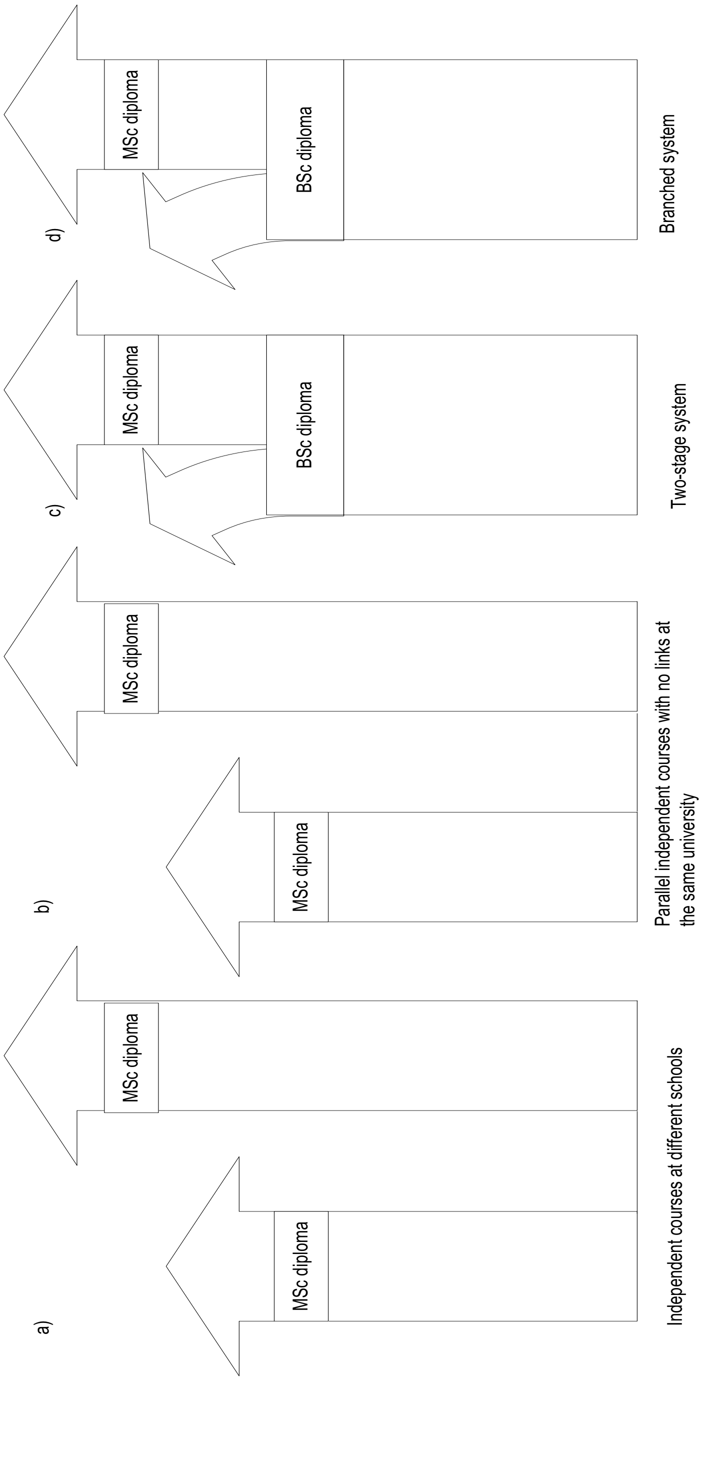

Figure 1. Study systems

Table 1 Subject names currently used in the curricula

Applied Mathematics
Algebra and Geometry
Applied Mathematics
Calculus
Differential Equations
Engineering Mathematics
Linear Algebra
Mathematical Analysis
Mathematics
Probability and Statistics
Statistics
Applied Informatics & Computational Methods
Informatics
Applied Informatics
CAD
Computational Methods in CE
Computer Assisted Drawing
Computer Methods in Structural Analysis
Computer Programming
Computer Science
Data Processing
Elements of Informatics
Fundamentals of Computer Science
Fundamentals of Informatics
Graphics and CAD
Informatics
Introduction to Computers and Programming
Introduction to Programming
Programming
Data Processing
Digital Image Processing
Strength of Materials
Introduction to Strength of Materials
Mechanics of Materials and Fracture Mechanics
Strength of Materials
Structural Analysis
Finite Element Method
Statics
Structural Mechanics
Structures
Solids and Structures
Analysis of Framed Structured
Computational Methods in Structural Analysis
Matrix Analysis of Framed Structured
Static of Construction
Structural Analysis
Structural analysis and design
Structural Engineering
Structural Mechanics
Structural Stability
Structures
Theoretical Methods in Civil Engineering
Modelling and Structural Analysis
Building Materials & Concrete Technology
Building Materials
Materials
Building Materials
Building Materials & Concrete Technology
Construction Materials
Construction Materials
Concrete Laboratory Course
Concrete Technology
Isolation & Concrete Technology
Building Construction
Building Construction
Building Construction & Building Physics
Building Construction Methods
Engineering Construction
Maintenance and Rehabilitation of Buildings
Pathology and Building Conservation
Restoration of Monuments and Sites
Construction Quality and Economics
Quality Control in Construction
Building Installations
Electrical Engineering
Building Services Systems
Sanitary Engineering
Water Supply and Sewer Systems
Water Treatment
Building installations

Building Services Systems
Design of Water and Wastewater Treatment Plants
Environmental and sanitary engineering
Sanitary Systems
Surveying
Topography
Computational Methods - GIS
Engineering surveying
Geodesy
Photogrammetry
Surveying
Surveying Measurements
Topography
Geodesy of Structures
Geodetical Control of Constructions
Geographical Information Systems
Photogeometry
Topographical Databases
Underground Surveying
Urban Geographical Systems
Structural Design
Design of structures
Building structures
Building structures
Fundamentals of structural design
Structural design
Structural engineering
Theory of building structures
Design of building construction
Design of buildings
Design of structures
Theory of bridges and other structures
RC bridges and other structures
Project design
Residential building design
Analysis and design of special structures
Building in seismic zone
Computer earthquake resistant design
Experimental methods and models for structural engineering
Industrial building construction
Protection against mining subsidence
Special structures
Special structures and foundations
Advanced design in building construction

Construction of large structures
Design of municipal buildings
Design of residential buildings
Hydrotechnic Structures
Water Structures
Harbour Works
Hydraulic Structures
Hydraulics Constructions
Maritime Engineering
River catchments management
Hydropower Construction
River Control
Urban Planning
City Planning
Regional and Urban Planning
Urban Planning
City Planning
Computers in Urban and Regional Planning
Regional Planning
Urban
Urban and Regional Planning
Urban Planning and Design
Analysis of urban and environmental systems
Land use planning
Urban and environmental engineering
Urban management
Introduction to Architecture
Architecture
Architecture technique
Architecture and Urban Planning
Development of Architecture
History of Architecture
Construction Technology & Organisation
Building Technology
Construction Site
Construction technology
Methods of Construction
Technology of Construction
Construction and Planning Methods
Technology of Construction
Building Technology & Cost Calculation
Building Technology & Organisation
Organisation of Assembly of Structures

Economics and Management
Economics
Management and Decision Analysis
Construction Management
Construction Organisation and Management
Principles of Construction Management
Business Administration
Construction Economics and Management
Economics and Management
Management for engineers
Management in Civil Engineering
Advanced management in CE
Management in CE
Methods for Decision Making
Urban Management
Water Quality Management
Water resources Management
Engineering Economics
Non-technical Science
Building History
Engineering Law
European Economy
Planning and Building Law
Public and Privat Law for Civil Engineering
Communication
Economics in CE
Engineering Law
European Studies
Foreign Language
Foreign Language and Technical Terminology
Humanity courses
Introduction of Social Sciences
Language
Law for Engineers
Social Sciences
Sociology
Public Administration
Numerical Methods
Numerical Analysis
Numerical Methods
Numerical Methods in Engineering
Numerical Methods in Mathematics

Applied Physics
Physics
Thermodynamics and Heat Transfer
Building Physics
Physics of Construction
Physics of Structures
Applied Chemistry
Chemistry
General Chemistry
Building Chemistry
Chemistry of Materials
Technology of Materials and Applied Chemistry
Water and Waistwater Chemistry
Engineering Graphics
Constructive geometry
Descriptive Geometry
Drawing and Composition
Engineering Geometry & Drawing
Geometry
Descriptive Geometry
Drawing
Engineering Graphics
Technical Drawing and Geometry
Technical Drawing
Mechanics
Applied Mechanics
Continuum Mechanics
Elasticity
Mechanics
Rational Mechanics
Solids Mechanics
Theoretical Mechanics
Mechanics of Solids
Civil Engineering Mechanics
Theory of Elasticity
Structural Dynamics
Dynamic and Vibrations
Dynamics
Dynamics of Structures
Dynamic and Seismic Engineering
Structural Dynamics and Earthquake Engineering
Introduction to Engineering
Engineering Design
Engineering Science
Introduction to Engineering

Building Studies
Engineering Projects
Complex Design
Applied Hydraulics & Hydrology
Applied Hydraulics & Hydrology
Fluid Mechanics
General Hydraulics
Hydraulic engineering
Hydraulics
Hydraulics and Hydrology
Hydrology
Hydrology and Water Resources
Surface Hydrology
Wastewater Treatment
Water Engineering
Applied Hydraulics
Elements of Computational Hydraulics
Hydrodynamics
Hydrodynamics of Bays and Reservoirs
Hydrologic Modelling
River Hydraulics
Water Resources Planning and Management
Hydrogeology
Hydrography and Hydroinformatics
Planning of Hydraulic Systems
Engineering Geology
Geology
Mineralogy and Geology
Engineering Geology
Engineering Geology
Geology for engineers
Geoinformatics
Geotechnics & Foundation Engineering
Soil Mechanics
Geotechnical engineering
Geotechnics
Groundwater
Soil mechanics
Soil Mechanics and Foundation Engineering
Soil Mechanics and Foundations
Introduction to Rock Mechanics
Introduction to Soil Dynamics
Advanced Soil Mechanics
Case Studies in Geotechnics

Databases for Geoinformatics
Geotechnics & Foundations
Foundations
Foundation Engineering
Foundation engineering
Topics of Soil Improvement – Reinforcement
Foundation of Large Structures
Concrete Structures
Concrete Structures
Design of Reinforced Concrete Linear Elements
Design of Reinforced Concrete Structures
Prestressed and Reinforced Concrete Structures
RC and Timber Structures
Reinforced Concrete
Reinforced Concrete Structures.
Concrete Structures
Precast concrete structures
Prestressed Concrete
Reinforced and prestressed concrete structure
Reinforced Concrete
Concrete Building Structures
Steel Structures
Design of Steel Structural Components
Steel Structures
Theory and design of steel structures
Steel Laboratory Course
Steel Building Structures
Steel Technology
Timber Structures
Timber Structures
Masonry Structures
Masonry Structures
Structural Masonry
Composite Structures
Composite Steel and Concrete Structures
Metallic and composite Structures
Underground Structures
Underground Structures
Theory of Underground Structures
Underground Concrete Structures

Bridges
Bridge Construction
Bridge Structures
Bridges
Advanced Steel Bridges
Environmental Engineering
Civil Engineering and Environment
Environmental Protection
Environmental engineering
Air Pollution
Environmental Hydraulics
Environmental Impacts
Water Quality and Pollution Control
Applied ecology for engineers
Ecology
Environmental impact assessment
Environment and Remote Sensing
Environmental Geology
Environmental Impacts
Environmental Protection of Urban Area
Pollution Control of Urban Areas
Soil- and Groundwater Protection
Waist Disposals
Transportation Engineering
Construction of roads, railways and airports
Traffic Design of Public Roads
Traffic Engineering
Traffics
Transport Engineering
Transport Infrastructures
Transportation ways
Transports
Transportation and highways Engineering

Airports and Air Transport Systems
Transportation Engineering
Transportation Planning
Transports and Urban
Transports
Highway facilities management and maintenance
Transport infrastructures modelling and design
Earth Works of Traffic Constructions
Intelligent Traffic Systems
Urban Traffic
Road Engineering
Highway Engineering
Highway Engineering
Highways
Road Communications
Road Traffic Management
Roads & Motorways
Advanced Design of Road Constructions
Design of Roads
Pavement Design
Railways
Railway Construction
Railways
Design of Railways
High Speed Railway Constructions
Final Project
Diplom Thesis
Diploma work
Final Project
Final Project Seminar

5. PROPOSED SUBJECT NAMES

Huge number of subject names handicaps the students' exchange. We never know what comprises a subject called *"Rational Mechanics"* (does the irrational mechanics exist?) or *"Structures"* (as we know it is Structural Analysis). It'll be much more intelligible if the number of subjects is reduced. In table 1 subjects are grouped and each group has its general name. These can be used as the recommended set of subjects in study curricula. The proposed set of general subject names is presented in table 2.

Table 2 General subject names

1. Applied Mathematics	20. Structural design
2. Numerical Methods	21. Concrete Structures
3. Applied Chemistry	22. Timber Structures
4. Applied Physics	23. Steel Structures
5. Applied Informatics & Computational Methods	24. Masonry Structures
6. Engineering Graphics	25. Underground Structures
7. Mechanics	26. Hydrotechnic Structures
8. Strength of Materials	27. Bridges
9. Structural Analysis	28. Composite Structures
10. Structural Dynamics	29. Urban Planning
11. Applied Hydraulics & Hydrology	30. Introduction to Architecture
12. Engineering Geology	31. Environmental Engineering
13. Geotechnics & Foundation Engineering	32. Construction Technology & Organisation
14. Building Materials & Concrete Technology	33. Economics and Management
15. Building Construction	34. Road Engineering
16. Building installations	35. Transportation Engineering
17. Surveying	36. Railways
18. Non-technical Science	37. Supervised Industrial Placement
19. Introduction to Engineering	38. Final Project

The total number of subjects is reduced to 38. The general subject names should be used only for this part of knowledge, which every graduate of Civil Engineering at the BSc level must know. In some cases the partition to courses connoted by numbers 1,2 etc. can be introduced. This refers for example to such subjects as “Concrete structures”, in which “Concrete structures 1” determines the basic rules of dimensioning and “Concrete structures 2” deals with designing of simple structural elements. If the material taught exceeds the basic part of knowledge, which should be familiar for each Civil Engineer the adjective “advanced”, “special” or “supplementary” should be added. This concerns MSc courses as well as optional and specialist courses (e.g. Advanced Concrete Structures only for students of Structural Engineering speciality).

The proposed set of subject names supplemented by the above rules enables quite precise determination of the material scope. More detailed information about the subject contents should be given in the programme.

6. PROPOSAL OF A CORE CURRICULUM FOR CIVIL ENGINEERING

In table 3 a proposal of a core curriculum for Civil Engineering BSc course is suggested. This should be treated as a first draft of such curriculum and the basis for broad discussion.

Table 3 Draft of Core Curriculum for Civil Engineering

Year	Core subjects	Year	Core subjects
First	Applied Mathematics	Third	Structural Design 2
	Applied Physics		Concrete Structures 2 cnt'd
	Applied Chemistry		Steel Structures 2 cnt'd
	Applied Informatics & Computational Methods		Construction Technology and Organisation 2
	Engineering Graphics		Economy and Management
	Mechanics		Transportation Engineering
	Strength of Materials		Urban Planning
	Building Materials & Concrete Technology		Introduction to Architecture
Year	Core subjects	Year	Core subjects
Second	Applied Hydraulics	Fourth	Industrial Placement
	Building Construction		Non-technical Sciences
	Building Installations		Final Project
	Surveying		
	Geotechnics and Foundation		
	Structural Analysis 1 & 2		
	Structural Design 1		
	Concrete Structures 1 & 2		
	Steel Structures 1 & 2		
	Construction Technology and Organisation 1		

As it is an initial proposal we don't try to impute any numbers of teaching hours or credit points to the proposed subjects, just claiming that these subjects should be present in the curriculum of each Civil Engineering course. According to the rules proposed above (section 5) all these subjects comprise just the basic part of knowledge, which is necessary for each Civil Engineer of whichever speciality. Obviously some extensions for each speciality as well as some individual features for particular university are not only admissible but in many cases also necessary. In the 4th year of studies we have introduced a Supervised Industrial Placement. In our opinion it should last full semester. The experience gained at some courses at the Civil Engineering Faculty of the Silesian University of Technology as well as the experience of many countries proved that it is extremely beneficial for students' education. Sometimes it is not easy to organise such practical placement, as it requires the co-operation of the construction industry.

7. CONCLUSION

To summarise the paper let us claim, that we are sure that something what can be called “Core of Civil Engineering curricula and programmes” is an essential prerequisite of the effective students exchange between European universities. Based on this conviction, a proposal of the unified subject names as well as a draft of a core curriculum for Civil Engineering BSc course have been presented, just to initiate the broad discussion on this problem. We invite everybody to such discussion. Please send the opinions and proposals for our e-mail addresses. We believe that the EUCEET network can be a suitable forum to discuss and solve the problem.

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THE IMPORTANCE OF HYDROLOGY IN THE CIVIL ENGINEERING EDUCATION

Radu Drobot[1]

***ABSTRACT**: Hydrology is an earth science providing knowledge about the formation, the circulation and the distribution of the water in the frame of the hydrological cycle, as well as studying the interactions between water, environment and human activities. Taking into account this large field of activity, Hydrology as a science is usually splitted into: Surface Hydrology and Groundwater Hydrology. In some cases, Water Management is also included in the frame of the hydrological sciences.*

1. SURFACE HYDROLOGY

Usually, Hydrology is perceived as a science studying the surface waters, beginning with the precipitation fall and continuing with the overflow, the formation of the temporary small streams and finally with the permanent hydrographic network.

Hydrology is studying the processes of the upper part of the river basins, using simplified models and methods to estimate the surface runoff; in the downstream part of the basins, River Hydraulics becomes more adequate to study the surface water flow.

Surface Hydrology can be splitted into Basic Hydrology and Engineering Hydrology. The first branch is equally necessary for engineers, physicists, agronomists or geographers, while the second one, dealing with mathematical modelling of the natural processes: rainfall, production function of the river basins, the transfer function or the routing function, is accessible mainly for engineers and physicists. The mathematical modelling involves not only a good understanding of the physical processes to be modelled but also knowledge of high mathematics (systems theory, operational research).

1.1 Basic Hydrology

This course is an introduction to Hydrology, being addressed within the framework of the Technical University of Civil Engineering to the students of the Faculty of Hydrotechnics who will make a career in the water field. The purpose of this course is to provide the basics for the understanding of the hydrological cycle and measuring the quantities of water in different phases of this cycle.

Of special importance are the chapters concerning the anthropic influence on the soil's infiltration capacity and the continuous increase of the surface runoff due to progressive urbanization, deforestation and different agricultural practices; the soil and the river bed erosion, the landslide and the decrease of the river discharge capacity are other major consequences of human activities which are examined from a hydrological point of view.

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The continuous registration of different hydrological values and their statistic treatment provide valuable parameters or data for designing hydrotechnical works: bottom gates, spillways, height of the embankments, bridges, navigation facilities a.s.o. or to establish the reservoirs' volume for water supply and flood control.

The contents of this course is briefly presented in Table 1.

Table 1 Contents of Basic Hydrology

No.	Chapters of the module	Number of hours
1	Hydrological cycle	2
2	River basins characteristics	2
3	Precipitation	2
4	Interception. Depression storage	1
5	Infiltration	3
6	Evapotranspiration	2
7	Streamflow	2
8	Hydrographs	2
9	Hydrologic measurements	4
10	Statistical treatment of the data	8
	TOTAL	**28**

1.2 Engineering Hydrology

Surface Hydrology and Hydraulics are complementary sciences. Hydraulics is considered a civil engineering science, generally applied for designing the water supply systems or sewerage systems. Still, for many years River Hydraulics has been a flourishing science, and in the last decades is going more and more towards the upstream part of the rivers; now, it is even climbing the slopes till reaching the runoff formation.

The natural processes taking place in the river basins are not entirely known and simplifications of the phenomenon must be made; Hydrology is the first approach to be used in these conditions. When there is a lot of available data and the natural phenomenon is more and more understood, more complex hydrologic models can be used: conceptual models in a first phase, distributed models subsequently. The hydraulic approach, even theoretically perfectly possible, cannot overpass the difficulties encountered when modelling natural systems, with hundreds or thousands of unknown parameters necessary in the case of distributed models. Surface Hydrology remains in these conditions an attractive approach even now.

The purpose of this course is to provide students, having basic training in Hydrology, theoretical knowledge and practical instruments to solve common tasks in their future engineering career: excess rainfall, direct runoff, river maximum discharge and flood routing. These results are necessary both in natural river basins and in urban areas. The adequate design of the hydrotechnical structures and their operation during extreme floods depends on the good understanding of the hydrological phenomenon. At the same time, the proper design of the sewerage system to evacuate the water due to intense precipitations requires knowledge of Hydrology. Urban Hydrology, usually included in Engineering Hydrology, aspires to become an independent branch of Surface Hydrology.

The mathematical modelling of the hydrological phenomena, based on the concepts of the systems theory, helps students to understand the deterministic relationships between inputs and outputs in the nature.

The contents of this course is briefly presented in Table 2.

Table 2 Contents of Engineering Hydrology

No.	Chapters of the module	Number of hours
1	Systems theory - basic concepts	2
2	Hydrological processes	2
3	Design storm	2
4	Production function	2
5	Transfer function	2
6	Routing function	4
7	Mathematical models of the hydrologic systems for river basins and urban areas	8
8	Extreme events in hydrology	2
9	Parameters calibration	4
	TOTAL	**28**

2. GROUNDWATER HYDROLOGY

Although Surface Hydrology is considered the most representative branch of Hydrology, Groundwater Hydrology is not less important. The knowledge of the different forms of existence of the water in soils and in aquifers is important not only for the complete understanding of the hydrologic cycle, but also for the quantitative and qualitative protection of this vital resource for the life and raw material for industry.

In many countries the aquifers resources are used as the main source for water supply due to their characteristics: a good quality and a small influence of the climatic conditions on the availability of the water quantities. Usually, the deep aquifers due to their natural protection against pollution are the main source for the drinking water supply of the large towns, while the small communities are exploiting by tradition the phreatic aquifers. In the first case, the local farmers from the small villages are extracting water through their own made fountains, without any knowledge of the physical or chemical processes of the shallow aquifers. Still, these aquifers are very vulnerable to pollution and, in fact, a large part of them is already polluted. In the future, there are two alternatives for the villages' water supply: either to use the treatment of the groundwater, either to develop regional water supply systems; both alternatives are very expensive. Those who are entitled to make a more reasonable option on the choice are civil engineers.

Of course, the collaboration with the geologists, which have knowledge of the extension of the deep or shallow aquifers is very important for the civil engineers specialised in the water field. Still, such a collaboration involves a common language with the geologists in general and especially with the hydrogeologists, which can not be achieved without having passed the exam of Groundwater Hydrology. The same course is extremely important for the evaluation of the influence on the goundwater levels of the hydrotechnic or other civil engineering works (dams, diversions, navigable canals, waterworks, metropolitans); the same problems arise when realising important excavations or after the realisation of huge civil buildings, with many underground floors which represent an obstacle for the grounwater movement.

A great importance for the groundwater resource is constituted by the natural recharge, a process taking place after the overpassing of the field capacity of the soils. The soil plays a buffer role, both for the water infiltrated from the precipitations and for the different pollutants from the industrial and agricultural activities. The understanding of the water or polluted balance, or of the physical and chemical processes taking place in the unsaturated zone is essential for the quantitative and qualitative protection of the aquifer water resources.

Finally, the irrigation systems realize the vegetation water supply using the soil capacity to store it. Many irrigation systems, all over the world, due to the lack of the financial means, but also due to an incomplete formation of the specialists working in this field, have led to important deep percolation with all known consequences: the continuous groundwater level rise, the soil salinisation and, not less important, huge losses of water and energy within the framework of these systems. The civil engineers which design the irrigation facilities are not at all conscious that the storage capacity of the underlying aquifers from the irrigated fields is not unlimited; at the same time, the water tranzit capacity of these aquifers is very reduced. The civil engineers working in the design of the irrigation systems have to possess good knowledge of the unsaturated zone process, and to be able to have a common language with the specialists in Agriculture and Land Reclamation.

The contents of this course is briefly presented in Table 3.

Table 3 Contents of Groundwater Hydrology

No.	Chapters of the module	Number of hours
1	Introduction	1
2	Saturated media	1
3	Movement of the groundwater	4
4	Field and laboratory tests	2
5	Unsaturated media	2
6	Aquifers and soil pollution	4
7	Soil and aquifers rehabilitation	2
8	Numerical methods	4
9	Mathematical modelling	6
10	Case studies	2
	TOTAL	**28**

3. WATER MANAGEMENT

Water Management represents much more than a technical discipline, meaning in fact the philosophy of using the water in a sustainable way. There is a strong conflict between the scarcity of water resources characterized by a non-uniform distribution in time and space and the continuous increase of water demands. The population's growth, the industrial development and the irrigated agriculture lead to a high pressure on the sources of water, both from rivers and from aquifers. Not only the available quantity, but also the quality of existing resources is threatened.

The water storage in reservoirs, its distribution among the users, the flood control, the water quality preservation and fighting against the incidental pollution are the most common tasks that civil engineers are usually called to solve.

The contents of this course is briefly presented in Table 4.

Table 4 Contents of Water Management

No.	Chapters of the module	Number of hours
1	Water resources	2
2	Water users	2
3	Water resources monitoring	2
4	Water legislation	2
5	Management strategies	6
6	Water resources allocation	4
7	Low flow management	2
8	High flow management	4
9	Protection of water resources	4
	TOTAL	**28**

4. CONCLUSION

Hydrology with all of its branches: Surface Hydrology (Basic Hydrology and Engineering Hydrology), Groundwater Hydrology and Water Management, is extremely useful for the civil engineering education and should have the same status as Hydraulics, another fundamental discipline largely accepted in the curricula. The interference of the engineering works with the surface or groundwater in its movement or with the water resources becomes more and more important. The students must understand these interactions and the reason of natural or legal constraints limiting their future actions, and to learn to cope with water and environment.

ON SOME ASPECTS OF STRUCTURAL ENGINEERING EDUCATION

T. Barakov[1], I. Totev[2] & Z. Bonev[3]

ABSTRACT: *Changes are necessary in the academic curricula of Structural Engineering in Bulgaria. The following factors have an impact on the direction of these changes:*

- *Globalization of world's economy;*
- *Usage of contemporary information technologies;*
- *Unfavorable demographic trends towards aging of population;*
- *Existence of many buildings needing renovation and strengthening.*

The first two factors are acting in a similar way in almost all countries. The last two factors are specific for Bulgaria and consequently are the subject of this study.

1. INTRODUCTION

There is a transition from planned to market economy in the last decade in Bulgaria. Economic and social spheres are undergoing reformation. These reforms are associated with considerable changes in the number and profile of the population. Birth rate went down sharply. Emigration increased and included a considerable part of the young and well-educated generation. All this reduced the need of new housing construction.

The relative part of the repairs and renovation of buildings was risen. Consequently, a necessity emerged of including new subjects in the academic curricula, related to building rehabilitation. A Master course with such contents is planned to be included in our educational programme. There is a considerable interest among the engineers in the industry towards such training. Short courses within the frames of the continuing education are being organised for them.

2. DEMOGRAPHIC AND TECHNICAL-ECONOMIC ENVIRONMENT

The population of Bulgaria in the last 100 years is growing at different rates up to the middle of 1980s. Then, a maximum of nearly 9 million inhabitants is reached. Figure 1 shows the variations in the number of urban and rural population.

Decreasing of population in rural areas begins in1946. This is due to industrialisation of the country and associated urbanisation. Urban population grows quickly in the period 1946-1985. This causes an acute housing crisis in the towns. To overcome the crisis, many large-panel blocks of flats have been built. These houses have been built in the years of planned economy without an in-depth analysis of their energy effectiveness.

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Decreasing of urban population is observed after 1985. This drop is at lower rate compared to rural population. Half of the general decreasing of population is due to emigration. About half a million Bulgarian citizens in working age have left the country in the last decade. The other half of the decreasing is due to lower birth-rate. At present, the number of population up to 18-years old is nearly the same as the number of the population above 61 years old. The two age groups of economically non-active population represent about 20% each. The above demographic data indicate clearly that a large-scale construction of new dwellings can not be expected in the near future. For its part, the economic situation in the country does not allow considerable investments to be made in this field.

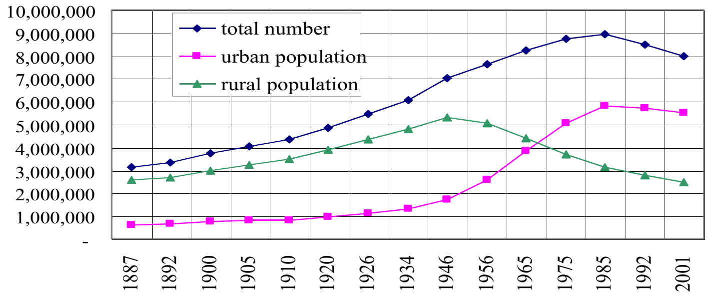

Figure 1. Demographic data about Bulgarian population

One specific characteristic of the period 1950-1990 is the absence of systematic cares for the already erected buildings and structures. This brings about damages from corrosion and breaking of the ground bed due to domestic and precipitation water. The low quality of construction works in this period is another reason for the non-satisfactory condition of the housing.

Improving the quality of life in already constructed buildings is sought in several directions:

- creation of hygienic conditions of life – running hot and cold water;
- economical and ecologically clean heating in winter – central or local hot water heating;
- optimal thermal insulation of buildings;
- increasing the acoustic insulation;
- creating possibilities to use contemporary information technologies – telephone, connection to Internet.

One of the above directions that needs special attention is increasing the thermal insulation. The prices of the energy carriers are being raised continuously causing the same with the costs of heating. For an average dwelling of 60 m^2, heating expenses in January and February reach 30-40 EUR per month. This sum may seem insignificant for the West European standard but in Bulgaria it is equal to 80% of the average teacher’s salary. The most effective improvement of the thermal insulation is reached when applying a protective layer outside on the whole building. The typical dwellings in the new quarters of the big towns in Bulgaria are large-panel 8-storey block of flats comprising 100-120 flats. Almost all flats are private. A considerable part of the owners are retired persons. This makes the investment in an external thermal insulation on behalf of the owners a very difficult task. Considering the importance of the problem related to the thermal insulation of the old buildings, the central and local administrations support a number of pilot projects in this field.

The unsatisfactory condition of buildings and structures not only reduce the quality of life in them but reduces sharply their reliability. Over 90% of the most densely populated part of Bulgarian territory is with a high seismic risk. The catastrophic results of the 1999 earthquake in Turkey indicate that urgent steps should be undertaken for the seismic hazard assessment for all buildings.

3. PRIORITIES IN EDUCATION OF CIVIL ENGINEERS IN BUILDING REHABILITATION FIELD

After degradation of the central state system in economy, Bulgaria is oriented towards market economy. The large state design and construction organizations were disintegrated. Their place was taken by a large number of small design and construction companies. They have limited financial capacity and fight for their survival and strengthening their position on the market. They are not in the position to participate in the financing of new scientific research and continuous education of their staff. This implies the education to be carried out in whole by the University. The necessary volume of knowledge of graduating students is expanded.

The development of technology allows efficient methods to be applied for improving the dwellings' operational parameters. Their efficient use need well–trained construction experts in the field of building maintenance effectiveness.

The Faculty of Structural Engineering understands also its responsibility for the satisfactory solution of this problem. This may be successfully achieved only through systematic efforts towards teaching and scientific research. Studying foreign experience and the international cooperation may reduce the time necessary for solving this immediate task.

The first step in the desired direction is naturally the improvement of teachers' training in the field of rehabilitation and strengthening of buildings and structures. Two lecturers from the Faculty have already passed a 2-year course in Building Rehabilitation in Dresden within the frames of the EIPOS Programme. One lecturer is in Japan on a long-term fellowship for seismic risk assessment. Another group of lecturers has raised their qualification participating in the TEMPUS programme. This preliminary training allowed systematic actions to begin for student training in rehabilitation and strengthening of buildings and structures. A representative of the Faculty participates in the international cooperation for prefab building rehabilitation.

An obligatory subject "Building Insulation" has been included in the curriculum for several years already. Topics have been selected in conformity with world-level technologies in the field. Close contacts are maintained with leading companies in this field in the country as well as with representatives of the world leaders in these technologies. The following subjects are offered as electives in 7th, 8th and 9th semester:

- Diagnostic of Damages, Repairs and Reconstruction of Buildings;
- Durability of Building Materials;
- Seismic Design of Structures.

A group of students conducted their diploma thesis preparation period in France on the problems of building rehabilitation within the frames of our cooperation with the University of Nantes. A cooperation agreement has been signed with Dresden University of Technology in this subject field too. A joint practical training is organised this summer in Bulgaria for German and Bulgarian students guided by Prof. Morgenstern and Assoc. Prof. Barakov. The Faculty will study any proposal for joint international initiatives in this respect.

Building rehabilitation and strengthening are among the main fields of research today. At present, the theses of three doctorate students are closely related to them. More than half of the research proposals financed by the Ministry of Education and Science are related to the condition of housing and structures.

The problem of preventing historical buildings and monuments from damages is also very important. Most of these buildings are unique as part of the historical heritage. Traditional design methods can not be applied directly. How to apply finite element method and what type of supporting structure to be selected are only two questions that can not be solved using traditional methods. The lack of knowledge in this field is evident.

A master course with this subject coverage is intended to be organised and carried out. The basic topics of this course are concentrated in:

- identification of the material properties;
- numerical and computer modelling of the existing structure;
- the choice of supporting structure or other method of strengthening; verification that the supported structure is more reliable and less vulnerable.

Aauthors are convinced that this course will allow better understanding of structural engineering profession and will contribute to compensating the lack of knowledge in this field.

4. CONCLUSIONS

A lot of investments now in Bulgaria are directed towards maintenance, repairing and strengthening of existing engineering structures. The emphasis is placed on rehabilitation and renovation of buildings that are already built. The knowledge about new technologies and materials is not enough to settle this problem. It is well known that in many cases the repairing and strengthening may appear to be more complex than to design a new building. It is necessary to establish the actual material data and then to accept measures for strengthening. It is clear that renovation requires additional knowledge.

The international cooperation in this field will contribute for solving the problems better and faster.

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MODULARISING ENGINEERING EDUCATION CURRICULUM - Manual of Good Practice -

Carsten Ahrens, Olaf Blümel & Ilka Gersemann [1]

ABSTRACT: *Various approaches have been proposed in order to give all professionals, including civil engineers, the possibility to work in an Europe without borders. Independent from these approaches, it is always necessary to achieve mutual recognition of the professional work and of the education of civil engineers. In order to facilitate academic co-operation and educational exchange, tools have been elaborated within the framework of the European Commission and some of them (like ECTS) have already been implemented in many European higher education institutions. Modularising higher education curricula is now under way and is seen as an opportunity for and a challenge to international engineering education. The paper makes a comprehensive presentation of the concepts applied in this respect, results obtained and experience acquired so far at the University of Applied Sciences Oldenburg. Emphasis is put on the development and designing modularised curricula, implementation of a credit system, definition of study levels, study and examination regulations, practical placement, transfer, grading and award system, development and implementation of quality assurance and evaluation procedures.*

BACKGROUND

Civil engineers all over Europe and the world are educated to build houses, bridges, waterways, railways and all the other constructions civilized people need and which have to persist years, centuries and even to survive in the third millennium. The results of civil engineers can be seen everywhere.

Civil engineers were educated strictly obeying the respective national regulations concerning academic and professional demands. But civil engineers at no time stood at home only but worked outside the national borders and under foreign construction regulations. Civil engineers have got very diverging national educations but they do their work on all national and international sites.

So, why modularising curricula in Europe and especially European Civil Engineering Curricula? And, how to modularise these curricula?

The EU has opened the borders between the member states to all professionals, and also to civil engineers. But what happens if a civil engineer wants to settle and make up his/her own professional office in a foreign country? Up to now a lot of obstacles have to be passed.

The ECCE group is hard working on installing a European Register of Chartered Civil Engineers to give all its members the possibility to work as an individual in a Europe without borders. But independent from different approaches it is always necessary to achieve mutual recognition of the professional work and, at least, of the education of civil engineers. This education must not be mirror like but equivalent and transparent to each other.

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1. INTRODUCTION

Co-operation in European higher education

International co-operation in education and training is promoted by the European Commission as a means of improving the quality of education. The mobility of students and teachers as well as joint curriculum development and joint study programmes are some elements of inter-university co-operation on an international level which are supported within EU educational programmes. The overall aim is to internationalise education for the benefit of students and higher education institutions.

In order to facilitate academic co-operation and educational exchange, tools have been elaborated such as the European Credit Transfer System which has already been implemented in many course programmes of European higher education institutions. Modularised curricula are another target of many institutions since along with ECTS they are expected to create more transparency in what the content and the goal of a study program is, to facilitate the exchangeability of course units (modules) and to make the use of ECTS more efficient.

On the European level, the opening of EU educational programmes such as SOCRATES-/ERASMUS and LEONARDO DA VINCI to higher education institutions in Central and Eastern Europe has brought up new opportunities and new challenges. Since the comparability and exchangeability of course units are a prerequisite for the academic recognition of work and study periods abroad and therefore also for successful student mobility, the common work on curriculum development is a means of creating a better understanding of study conditions in other European countries.

2. MODULARISING HIGHER EDUCATION CURRICULA: AN OPPORTUNITY FOR AND A CHALLENGE TO INTERNATIONAL ENGINEERING EDUCATION?

2.1 Qualification profiles of graduates in engineering

The globalisation and the related changes which are taking place in the world of work bring about great challenges to institutions involved in education and professional training. The qualifications employers require from graduates are quite different from what they were one or two decades ago. This is specifically evident for graduates in the field of engineering.

Different studies have been carried out giving a good overview of the changing conditions in the economy which lead to new circumstances in the work environment of engineers. Some aspects are briefly presented in this chapter.

2.1.1 Changing conditions in the world of work

Globalisation can be seen as one of the main reasons for changing conditions in the world of work. In this world wide process nation state borders lose their significance for economic activities, and efforts towards internationalisation are mainly a reaction to this process.

International activities and contacts are not entirely new, especially not for large international enterprises, but the internationalisation of markets is an enormous challenge to small and medium sized enterprises, especially in export-oriented economies. The growing competition may result in

- new organisational structures in enterprises which require more intensive contacts to clients on all levels of the enterprise,
- more pre and after sales activities (e.g. including services) improving the offered product,
- increasing pressure on prices, the fading traditional unity of the enterprise (e.g. more outsourcing activities) and the development of more co-operation activities,
- the widening of qualification requirements, and
- the necessity to work on different innovations (product, process, services) simultaneously (Uhrmann-Nowak, Keuper, Mesenholl, Beck, Leberecht 2000).

Qualification profiles

The rapidly developing markets for information and data processing, telecommunication, multimedia, material sciences, micro systems technology or quality assurance might offer a range of career opportunities for engineers in the future. The Association of German Engineers (VDI) states that the new work fields require more complex qualifications from engineers with a trend towards more general skills qualifying for the profession of the engineer than extra-functional skills qualifying for a specific and limited work field.

Careers

During their career, many engineers leave the work field they used to work in and start working in less technical and less engineering-oriented fields (e.g. management, sales, etc.). Furthermore, some new fields of specialisation which require extra qualifications develop as a consequence of, for example, the growing consciousness for environmental protection: special knowledge in resources, energy, recycling or waste management are therefore demanded.

Some new or so-called diagonal qualification profiles are designed, e.g. industrial engineering or other special degree programmes for positions between engineering and business management. The development of services companies (online services, consulting etc.) might also offer new opportunities for graduates in Engineering.

Knowledge

Knowledge has become a new production factor of growing importance. The currently dominating lines of business are focused on intelligence and human potential. They are practically able to settle everywhere in the world; thanks to new technologies and world wide electronic networking knowledge can be retrieved anywhere (VDI 2000).

Future demands of engineering education

Of course, it is impossible to make exact predictions for the future demand of engineering qualifications on the European labour market, but it can be stated that the different developments related to the globalisation of markets may lead to a significant change of the work fields of engineers and therefore to new demands of qualification profiles.

Uhrmann-Nowak et al (2000) have proposed a new definition of the required engineering qualifications which can be briefly summarised as follows:

- More flexible organisational structures, a focus on teamwork; rapid changes and less rigid hierarchical structures require interdisciplinary competencies.
- The exemption from time intensive technical tasks and routine operations through the aid of computer technology leads to a shift of the engineers' tasks to more complex issues and to the need of strategies to solve problems. The finding, structuring and analysis of the immense mass of information available becomes an important aspect of engineers' work.
- Skills in business management, occupational science and educational skills are of growing importance.
- Because of the more hybrid supply of products, engineers will be increasingly involved in researching the clients' benefits, in design and calculation from the business management standpoint, as well as in logistics of product or client oriented services.
- Intercultural competencies and language skills are demanded where companies operate on international markets.
- Social competencies, willingness to take over responsibility, and other characteristics of a strong personality become distinctively important where teamwork and flat hierarchies belong to the organisational structure of a company.

In order to gain an overview of what kind of qualifications engineers need to have for being successful in their position, it is most helpful to ask this information from potential employers in the respective line of business.

2.1.2 The role of higher education

If higher education institutions want to meet the challenges which arise from changing conditions in the economy or in society in general, it is important to think about the role of higher education.

Considering long-term functions of higher education

Teichler (1999) explains that the realisation that "*the more knowledge becomes a productive force, the more higher education is expected to contribute visibly to the economy and society*", has also lead to concerns that higher education concentrates too much on satisfying immediate and short-term industrial demands and neglects its function to foster intellectual enhancement, critical thinking, preparing for indeterminate vocational tasks and contributing to innovation. Although experts' views on the composition of knowledge most appropriate may differ, there is more consensus on the mission of higher education not to confine its role to the transmission of knowledge, but rather to follow a more holistic or integrated approach.

Structures for study programmes

Having all these demands and challenges of engineering education in mind which are described in chapter 2.1.1 it seems to be essential that suppliers of engineering education are prepared to react quickly to changes in the demand for engineering qualifications. Modularised curricula may improve this scope for action and provide higher education institutions and students with better opportunities to design curricula according to the needs of students since they ease the transfer of certain qualification units and therefore diversify the supply of educational programmes.

2.2 A policy towards internationalisation and convergence in European higher education

Trends in learning structures

One of the major trends Haug observes in many countries is a strong governmental push towards shorter studies, reducing the *real* duration of studies to the official. More recently, governments have articulated plans to reduce also the theoretical duration of studies. The development of two-tier curricula including a shorter first qualification plus postgraduate studies can also be seen in this context. In many European higher education institutions which traditionally used to offer long curricula, two-tier curricula have been introduced in recent years, leading for example to Bachelor and Master degrees. In addition, international degree programmes taught in English are developed and national degrees are compared with foreign degrees.

Four main avenues of combined action which may foster the desired convergence and transparency in the structure of qualifications in Europe are suggested:

- the gradual adoption of an ECTS-compatible credit accumulation system,
- the adoption of a common, but flexible frame of reference for qualifications,
- compatible quality assurance systems, and
- empowering Europeans to use the new learning opportunities.

Haug (1999) formulates key attributes of a ”*European Higher Education Space* ” which might also serve as guideline principles which should also be kept in mind:

- ”**Quality**: reforms concerning credit systems or degree structures cannot substitute efforts to improve and guarantee quality in curricula, teaching and learning;
- **Mobility**: the most powerful engine for change and improvement in higher education in Europe has come, and will come from growing awareness of alternative approaches and best practice in other countries;
- **Diversity**: measures not respecting the fundamental cultural, linguistic and educational diversity in Europe could endanger not only the progress already made, but the perspective of continuing convergence in the future;
- **Openness**: European higher education can only fulfil its missions within a world wide perspective based on competition and co-operation with other regions in the world.”

2.2.2 Equivalence and comparability

The higher education systems in Europe and the respective curricular and degree structures are extremely complex and diverse. The differences occur in the organisation of secondary education as a preparation for higher education, the existence of sub-systems of higher education, access to higher education, tuition fees, organisation of studies in terms of calendar, and the type of degrees that can be earned. Since even the national system may be highly complicated one has to consider that the European education market cannot be less complex.

2.3 Defining the target of curriculum development

Curriculum development is a continuous process if quality standards are to be assured in the long term. The running of the programme, its success and the relevance to the present demands of society and the world of work must be evaluated on a regular cycle. Nevertheless, one has to differentiate between designing a new curriculum, giving a curriculum a complete new structure and up-dating a curriculum. In order to deal with curriculum development efficiently, one has to analyse carefully the status quo and what targets are to be reached.

2.4 A concept for modularisation

2.4.1 Purposes and benefits of modularisation

A short and precise description of the advantages of modularisation can be found in a discussion paper of the Higher Education Authority in Ireland in which it recommends Irish higher education institutions to introduce semesters instead of academic years together with the implementation of a credit point system and modularisation. The motives for modularisation explained here are very similar to those the partner institutions of the Leonardo project consider essential.

"Modularisation is a response to the growing need for flexibility and permeability in higher education. It has as its main purposes:

a) To provide an institution with flexibility in the design of its courses.
b) To increase the potential number of pathways to awards in the total course provision of an institution.
c) To identify and provide new and interdisciplinary pathways to awards.
d) To provide a structure which enables the admission and participation of a diversity of entrants, including mature students, part-time students and the "standard school leaver".
e) To facilitate student transfer between institutions.
f) To provide institutions with opportunities to review course objectives, learning outcomes and strategies and assessment methods.
g) To improve the quality of teaching and the economic use of teaching resources (including shared teaching across courses and feed-back on student performance)." (HEA, 1994)

The introduction of modules and credits is expected to guarantee easier transfer of academic performance as well as options to accumulate them. Furthermore, students shall have the possibility of designing their academic education individually without higher education institutions having to invest in an expansion of study offers. So a better use of resources can be expected.

2.4.2 Finding a definition for "modules"

Not all the approaches to modularisation are the same and not all concepts for modularised curricula are identical, and they do not need to be. But it is essential to agree on a concept within one institution and it is very useful to agree on a concept with other institutions (e.g. partner institutions, institutions in the same region or in the same state).

General principles

In its overall guidelines on modularisation and credit point systems the German Standing Conference of Ministers of Education and Cultural Affairs (2000) defines modularisation in the following way (*translated by the authors*): "Modularisation is the process of putting together subject areas to assessable course units which are rounded off and complete in terms of topic and time and which are provided with credit points.

Modules may include different teaching and learning methods (e.g. lectures, exercise classes, work placement etc.). A module may contain the contents of a single semester or an academic year, but it may also cover more semesters. Modules are in principle concluded with exams on whose basis credit points can be awarded."

Designing modules by defining the learning objectives in the beginning appears to be a must nowadays. The classification of modules in terms of study levels makes it not only easier to keep to the curriculum, it also facilitates student mobility.

2.4.3 Concept for modularising engineering education

At the Oldenburg University of Applied Sciences, a concept for modularising engineering education curriculum was developed by Carsten Ahrens (Department of Civil Engineering) which can be adopted easily by other departments of the institution or by other engineering departments. In this chapter, the general principles of this concept are briefly described in order to present one sample and to explain on which principles a concept can be based. This concept as well as the concepts of Tallinn College of Engineering and Jyväskylä Polytechnic will also be the basis for the 13 steps to modularisation suggested in chapter 3.

Definition of the learning objectives

The process of designing a curriculum is ***not input-oriented, but output-oriented***. That means that the learning objectives of the degree programme are determined before the curriculum is designed and that the learning objectives of a module are defined before the module is designed. The learning objectives have to be borne in mind during the whole process. It is not only essential in terms of the programme's contents, but also in terms of learning environment, teaching methods, special elements of the curriculum such as study and work abroad periods or work placements etc.

Size of modules

The size of all modules in terms of contact hours and workload is the same. Exceptions are allowed where necessary, but in general, one module consists of contact hours and self-study at a ratio of approx. 50 : 50. In this concept, one module consists of three contact hours and approx. three hours of self-study per week. A module is completed in one semester. If more workload is necessary for a specific subject, a second module can be offered in the next semester (e.g. Mathematics I and Mathematics II). The modules include all teaching, learning and assessment associated with that partial qualification. Five credits are awarded per module which is completed successfully. Seven modules are studied per semester; six of them have to be passed in order to complete the semester successfully. Regulations for failure must be developed.

Structure of the degree programme

The Oldenburg concept assumes that - corresponding to ECTS - students have an annual workload of 1680 hours (42 weeks x 40 hours) or 840 hours per semester (21 weeks x 40 hours). This time frame includes periods for exams, exam preparation etc. Depending on the degree programme and the qualification to be attained the total duration of the programme may vary. The industrial placement is one of the core elements of the curriculum. It has to be completed at a certain study level. A sample for the academic calendar can be found in chapter 3.4.1.

Continuous assessment

As mentioned above, assessment takes place for each module. As in this concept one module is studied in one semester, assessment also takes place within this semester. Students are assessed on a regular basis instead of being assessed in intermediate or final examinations. Nevertheless, a final thesis is also regarded as a kind of final examination since knowledge and methods are applied on a specific project.

Credit point system

The credit point system which is used for this concept of modularised curricula is the European Credit Transfer System (ECTS). This system will also be the basis of a discussion on a credit accumulation system. ECTS credits are a numerical value allocated to modules which reflect the student workload (including lectures and seminars, private study, field work, tutorials, assessment activities etc.) required to complete the module. 60 credits represent the workload of an academic year (30 per semester).

The credits do not represent the academic performance in terms of quality, but the system provides a frame of reference for grades which can be translated into the national grading system. Instruments of ECTS which are used along with credits are an information package which supplies written information on the institution, the respective department, the degree programme and on each module, a transcript of records which shows students' learning achievements and a learning agreement covering the programme of study to be taken during study abroad periods. These instruments provide the transparency which is needed for successful student exchanges.

Study levels

Since the partial qualifications which can be acquired in one semester are part of a complete qualification which leads to a degree, they have to be considered as consecutive qualifications which must be attained in a specific order. The modules have to be taken in a certain sequence. The partial qualifications have specific levels, so prerequisites are necessary to be able to follow a module on an advanced level.

Integrated work placement

A work placement of one semester is part of the engineering curriculum. For the completion of the work placement, 30 credit points are awarded - the same amount as in a regular semester. It has to be completed on a specific study level since certain qualifications have to be acquired beforehand.

Evaluation and quality assurance

Evaluation and quality assurance are key elements of curriculum development in order to be able to compete on the global education and labour market. In order to make sure that a programme is run efficiently, that the transferred qualifications are up-to-date and in line with the demands of the labour market and in order to offer an attractive programme for the students, the institution or the department should evaluate on a regular basis and implement a quality management system. These activities have to be planned in line with the legal frame for quality assurance which might already be given by the authorities. Information on the demands of the labour market can be gathered through questioning potential employers, regular meetings with experts or feed-back from alumni.

Transparency

Transparency is a very important aspect in curriculum development, especially when student and teacher exchanges are planned on a large scale. Therefore, the aims, contents and organisational principles of the degree programme have to be described as well as objectives, contents, teaching methods, assessment etc. of each module. This happens according to a specific scheme which is described in more detail in chapter 3.

3. DEVELOPMENT OF A MODULE BASED CURRICULUM

3.1 Policy Statement and Mandate by the Institution

The organisational structures of European higher education institutions are quite different and so are the legal frameworks for higher education. Furthermore, the move towards an academic reform may be a top-down or a bottom-up process, depending on various factors. Hence, recommendations on the responsibilities in the reform process cannot be given here. Still, if an institution intends to modularise curricula, it can be recommended to create "ideal conditions" for the process in order to guarantee efficiency and transparency. Suggestions are listed below.

3.1.1 Policy statement

Institutions of higher education formulate different types of statements about their plans for institutional development; policy statements, mission statements, and European policy statements are requested for the participation in educational programmes of the European Union etc. If an institution plans to carry out an academic reform, to modularise and / or to internationalise curricula, these plans should be taken down in the respective policy statement in order to attach importance to the matter.

3.1.2 Working group

In order to integrate different persons with different responsibilities into the process, a working group for modularisation should be installed. The process is a very complex one which cannot be left to a single person. As more people from different departments, faculties, administration units etc. are involved in the process, they must work together and exchange their opinions and needs, and work out proposals together. This should happen on a regular basis, co-ordinated by somebody officially responsible. The people involved should be familiar with the degree programmes and with the principles concerning the intended academic reform. Within this reform process, the tasks and responsibilities of the group have to be determined, as well as the responsibilities of other faculty or administrative staff.

3.1.3 Mandate and authority

The working group and the involved persons should receive a mandate by the institution and certain authorities. Since the reform process might find not only supporters within the institution, the institution can foster the co-ordinator's or the working group's work by giving them a mandate for the modularisation process. In order to make sure that they have an appropriate scope for action, they should be provided with the necessary authorities alongside the legal framework for an academic reform.

3.1.4 Organisational structure

An organisational structure is needed which settles the responsibilities, decisionmaking powers, report duties, assemblies, communications etc. Of course, such a structure already exists in higher education institutions, but it has to be sorted out if the modularisation process needs certain features or special support and if the structure has to be reorganised in some way.

3.2 Description and Evaluation of the Status Quo

Before a curriculum is designed or re-designed, a description of the existing curriculum has to be written and an evaluation of the degree programme should take place. Many elements of the old curriculum will be kept in the new curriculum, but the institution will intend to make sure that the contents and structure are up-to-date. Apart from the description of the following aspects, it is particularly important to create charts which visualise the structure of the degree programme and summarise its contents. Charts will make the changes transparent and they allow a thorough comparison of the old and new curriculum.

3.2.1 Time frame

The description of the time frame of a degree programme has to include the following aspects:

Duration of the degree programme
Academic calendar
Student workload

3.2.2 Organisational aspects

All organisational aspects that affect the schedule and the running of the programme have to be considered in the description:

- Number of contact hours (for the full programm as well as per semester per week)
- National holidays
- Exams and exam periods
- Excursions
- Projects
- Time-table
- Etc.

3.2.3 Teaching methods and learning environment

All necessary information on teaching, teaching methods, and learning environment for students enrolled in the respective degree programme has to be collected. If a certain mission or policy for teaching exists it has to be mentioned in the description. Some aspects are suggested here:

- Combination of subjects
- Course units offered (i.e. number of units, structure, work load, importance and role of the subject, type of the course unit such as lecture, exercise class, seminar, laboratory work etc. ...)
- Classification of the subjects to a category (e.g. Mathematics/Natural Sciences, Technical Knowledge, Interdisciplinary Studies/Neighbouring Subjects, Methodological Competencies, Management/Communication /Social Skills etc.)
- Student/teacher ratio
- "The way of learning" (inclusion of practical work, work on projects etc.)

3.2.4 Administrative matters

All regulations and documents on administrative matters have to be listed. These may concern the following matters:

- Application/Registration procedures (for the course, for single study units, for exams etc.)
- Study regulations
- Examination regulations
- Practical placement regulations

3.3 Survey and Determination of the Needs and Requirements

When it comes to designing or reforming a curriculum, it is necessary to consider the needs and requirements of those who demand a certain kind of education or training, i.e. especially students and potential employers. These groups are most directly concerned with the education profile graduates will attain in their degree programme. So it is helpful to collect information on the requested qualification profiles of graduate engineers by consulting potential employers and graduates. This can be done in various ways and with different methods.

The qualification profiles of graduates and the opinions and ideas on curriculum development should be investigated internally and externally, i.e. within the institution and outside. The following target groups for questioning activities can be suggested:

Internal:

- Students
- Teachers
- Administrative staff (student advisors, career services, responsibles for practical placements etc.)

External:

- Potential employers
- Professional associations
- Alumni
- Experts
- Experts from neighbouring professional fields
- Employment authorities

For the research on requested qualification profiles different modes and techniques of questioning can be applied. Some are briefly described in the following chapters. Some samples of questionnaires can be found in the annex.

3.3.1 Researching into internal (institutional) demands

If an internal questioning takes place in order to collect ideas and opinions on future curriculum development, teaching staff and administrative staff can be asked for their ideas of students' qualification profiles since they may have developed some impressions during their daily work.

Students can be consulted in order to measure their contentment with the degree programme and for example with teaching, advising, facilities etc. at the faculty. Questions may concern the listed issues.

- Reasons for choosing a specific institution and a specific degree programme
- Professional objectives
- Teaching
- Advisory services
- Workload
- Proportion between contact hours and self-study
- Quantity and quality of exams
- Technical equipment of the institution
- Balance between theoretical and practical elements of the curriculum
- Industrial placement
- Improvement of the curriculum

Furthermore, if the institution / the faculty considers to offer further study programmes, the students' interests can be analysed beforehand. In a questionnaire, a range of organisational types for study programmes and specific subjects can be offered for the students to choose from:

- Short/Intensive programmes
- Bachelor Degree
- Master Degree
- Postgraduate programmes
- Study / work abroad programmes
- Part-time studies
- Continuing education
- Others (to be specified by the student)
- Certain subjects (to be specified by the respective faculty)

3.3.2 Researching into external demands

Special consideration should be given to the requirements of the world of work because the conditions at the work-place and the contents of the work are changing and will be changing as a consequence of globalisation, technological development etc.

In order to find out what kind of qualifications are needed in the world of work, it is suggested to involve potential employers, alumni and experts in the respective professional field. Below, some proposals for target-oriented surveys and questioning activities are presented.

3.3.2.1 Questioning potential employers

Questionnaires for potential employers may include questions on the expected quantity of graduates needed in the short-term and in the long-term, on average salaries or career opportunities, but they should concentrate on qualifications requested from the engineers. Some recommendations for designing the questionnaire, topics and questions are suggested below.

RECOMMENDATIONS

In order to boost the response rate, the cover letter should

- be no longer than one page,
- contain a logo of the institution,
- include a pre-paid envelope,
- contain the following information: topic of the survey, incentives (if there are any), explanation why the requested information is so important, how the questioned people/companies were selected, assurance that the given information is treated confidentially, phone number and e-mail address if the respondent has any enquiries, procedure of the survey, publication of the study etc.

Furthermore:

- The objective of the investigation has to be clearly defined. If the main objective is to receive information on qualification profiles and suggestions for the development of curricula, the investigation should focus on this topic.
- The addressees of the questionnaires should be informed about the objective of the analysis in the letter which accompanies the questionnaire and / or in the beginning of the questionnaire.
- The questionnaire should be sent to a wide range of potential employers. It has to be borne in mind that only 20% or 30% might answer the questionnaire and send it back.
- A questionnaire can also be used to receive an evaluation of the existing curricula. But since valuable information for curriculum development can be gathered, it is recommended to ask the employers not only for their opinion on the existing curricula, but to ask them for specific advice and suggestions for future curriculum development.
- The questionnaire should contain questions concerning the enterprise / potential employer, concerning the profile and the contents of the new curriculum and maybe also concerning the special features of a degree programme, such as integrated industrial placements, study or work abroad periods etc.

3.3.2.2 Questioning alumni

A survey of alumni can be a means of evaluation, a research project on the whereabouts of graduates and their career opportunities and also a way to collect proposals on the future development of curricula. This kind of research projects is often carried out on a large scale. But it can also be put into practice on a smaller scale, for example, just for a specific degree programme. Alumni Networks may be of great help here. In this section, not all opportunities, options for answers etc. of a broad survey can be mentioned. Only some general questions and topics for questioning alumni will be suggested. The answers offered in the questionnaire might offer a scale of grades between one and five, or one and ten. In some questions, a couple of sentences are requested.

3.3.3 Defining the learning objectives of the degree programme

When surveys and studies are carried out, much information on the educational needs and requirements will be available, which has to be structured in a way that it is useful for curriculum development.

For graduates of the respective field a list of qualifications can be created, which are requested by potential employers or recommended by alumni or foreseen by experts. If these qualifications can and shall be delivered by the institution / the faculty, the list may represent an outline of the learning objectives of a degree programme.

3.4 Designing Modularised Curricula

When curricula are designed on a modular basis, several structural and organisational changes will become necessary. It is essential to find a solution for these changes which is going to be carried out by the whole institution. The structural and organisational matters will concern the time frame of the curriculum, the module structure, teaching methods or information systems (course catalogue, student handbook etc.). Of course, an institution may work with well proven systems which do not have to be changed necessarily. This may concern, for example, the time frame of the weekly time-table as will be presented below, or the credit system.

Before a curriculum is filled with contents, it is useful to find a framework within the institution which gives some guidelines to the faculties, but leaves them enough flexibility to design the curricula according to the special needs of the subject area.

3.4.1 Time frame

The time-frame of the curriculum has to be defined according to the complete student workload of a degree programme. The complete duration depends very much on the awarded degree. Apart from the calculation of the student workload per semester, the time-frame for the academic calendar must be arranged. The time-frame should be flexible enough to arrange extra offers, such as excursions, intensive programmes, projects etc.

The following time frame could be the basis for the academic calendar:

Semester: 21 weeks = 840 working hours						
Prepa-ration	**Exams (pre-seme-ster)**	**Contact period: 15 weeks**			**Exams**	**Further study**
		lectures, seminars, tutorials etc	excursion, intensive programme, project week etc.	lectures, seminars, tutorials etc.		
2 weeks	**1 week**	**15-1-x weeks**	**1 week**	**x weeks**	**1 week**	**2 weeks**

Figure 1 Academic calendar

The structure of the whole degree programme varies according to the degree and the qualification being acquired. The following sample shows a possible structure for a programme of four years. Seven modules are studied per semester. Excursions, intensive programmes etc. can be offered additionally.

3.4.2 Module structure

The module structure may be defined according to the pattern given below. This pattern describes how a study unit or a module can be filled with contents. It illustrates the most substantial elements of a study unit which have to be kept in mind in the process of designing modules.

Requirements in the world of work		
1. semester	qualifications to be achieved (specialist knowledge + transferable skills) learning objectives course contents + teaching methods prerequisites	x credit points

Figure 2 Module development

3.4.2.1. Definition of modules

In order to put transfer, accumulation and mutual recognition of modules into practice efficiently, it is essential to agree on certain criteria for modules. The more suppliers of higher education degree programmes (faculties, institutions) reach an understanding referring to the definition and criteria of modules, the more opportunities for curriculum development may be worked out later.

Within the LEONARDO DA VINCI Pilot Project, the partner institutions agreed on the following criteria for modules:

- A module is an assessable course unit whose learning objectives are clearly defined.
- A module has the character of a partial qualification which is a component of a complete qualification (e.g. a degree). It includes all the teaching, learning and assessment associated with that partial qualification.
- All modules are classified as belonging to a specific study level. Prerequisites or entrance requirements are defined for each module.
- The module's student workload is measured with credit points.
- Modules may include different teaching and learning methods (lectures, seminars, project work etc.).
- Usually, the duration of a module is one semester.
- All modules offered within the institution have the same size in terms of workload.
- Detailed written information on each module has to be provided according to a certain scheme (see also chapter 3.4.3).

3.4.2.2 Learning objectives and content of a module

Nevertheless, in order to design one individual module, one has to define the learning objective and derive the contents and methods from the objective again, keeping in mind the structure presented in chapter 3.4.2.

3.4.2.3 Workload and award of credits per module

The basis for calculating the number of credits should be the workload. According to the Oldenburg model, all modules have the same size in terms of workload or credits, so the modules are designed with this precondition in mind. The relation between self-study and contact hours shall be approx. 50:50. The number of credits awarded for the successful completion of a module is always the same. This method is quite easy to handle. If modules are different in size and workload, certain factors for calculating the number of credits to be awarded have to be found.

3.4.3 Description of modules

One of the most important preconditions for student exchanges among institutions of different countries is transparency. It is not only important to provide information on modules; it should be published in such a way that it is easy accessible for students, teachers, administrators, partner institutions etc. The best medium to deliver the data to all these groups will probably be the Internet. The information should also be provided according to a certain scheme in order to improve readability and understanding of the given information.

The following checklist for information on modules can surely be extended, but none of the aspects should be missed:

- Title of module
- Module code

- Degree programme(s) for which the module can be attained (optional or compulsory)
- Subject Area
- Study level (year / semester)
- Learning objectives / competencies to be attained
- Entrance requirements / prerequisites
- Contents
- Bibliography
- Course organisation (composition of modules, lecture, exercise class, laboratory work, self-study, etc.)
- Time frame / contact hours
- Assessment
- Workload / credit points
- Teacher(s)

A form for the description of modules is probably the easiest way to collect the information on modules within an institution.

3.4.4 Teaching methods and learning environment

It has been mentioned earlier that teaching methods and learning environment may essentially contribute to the development of demanded or highly appreciated skills like communicative skills, the ability to team-work, the knowledge or development of problem-solving strategies etc. Students are given the opportunity to experience and develop these qualifications within the course programme. Useful ideas and principles which help fostering such transferable qualifications were found in the Faculty of Technology's (Hanzehogeschool, Hogeschool van Groningen) "Vision on Education" of which some ideas are summarised below.

Learning to learn is a basic condition for the study process. Students should be stimulated to increasingly use their own initiative and to take responsibility of their own learning process. If necessary, teaching and studying should change its ways and focus on learning meaningful application instead of reproductive learning. Students should be taught how to acquire knowledge and skills and they should be actively involved in the learning process, something that requires active intake and processing of new learning matter. They need orientation, the provision of the opportunity to practice, monitoring of study results and the provision of feedback. The teaching methods should be combined in a way that all these needs are fulfilled.

Again, it will be of much use to integrate experts from the professional field as well as specialists in education and the theory of teaching and methodology.

3.4.5 Weekly time-table

A weekly time table can be designed according to the needs and requirements of the institution or the students. The size and number of modules roughly determines how a weekly time-table might look like, although modules may also be split up and do not necessarily need to be taught on one day.

Examples:

Assuming that

- seven modules are taught in one semester,

- that one day shall be reserved for private study,
- that one afternoon is needed for self-administration work in committees,
- and that modules for further study are offered in the evenings, the following time-table could be designed:

Time	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
08.00 - 11.15		Module 3		Module 4	Module 6
11.30 - 15.30 (incl. 1h lunch break)	Module 1	*time for committees*	*self study time*		Module 7
15.45 - 19.00				Module 5	
19.00 - 22.00	Module 2				

Figure 3 Timetable (module slots)

This time table is based on more or less the same time structure that has been used at the Oldenburg University of Applied Sciences for many years. The customary hours do not need to be changed. The sample also includes the option for evening modules which might be used for further education.

3.5 Implementation of a Credit System (ECTS)

Credit systems are crucial elements of modularised curricula. In the context of academic reforms, they are important instruments which bring further efforts to improve student mobility, transparency of teaching and learning, consecutive degree programmes, life-long learning, etc. in terms of the organisation of studies and exams. They are applied in many different countries and education systems. Usually, credit systems are based on the objective to improve the "studiability" of curricula. Continuous assessment always plays an important role in credit systems (Teichler, Schwarz 2000).

On the European level, the European Credit Transfer System (ECTS) has become broadly accepted as it had been tested and has now been used for a couple of years, especially in degree programmes with large numbers of mobile students. If the comparability of degree programmes or individual study sequences is to be increased, it is recommended to use ECTS as a basis for the credit system or a credit system which is compatible to ECTS. It should be considered that the desired improvement of transparency, student mobility etc. will only be successful when some standardised guidelines are observed.

As most credit systems, ECTS is mainly a standardised calculation of student workload. Its objective is to ease the transfer of credits as part of, or within the bounds of mutual agreements.

3.6 Definition of Study Levels

One of the strategies to approach and reach the learning objective of the degree programme should be the arrangement of the course units or modules in a curricular order. The completion of course units in any order holds the danger that the contents are acquired without having the knowledge of the context. In order to prevent this lack of coherence it is essential to define study levels which the modules belong to so that they are studied in a specific order. The formulation of prerequisites for each *module, leading to more homogeneous groups in the classes, is therefore also a measure to guarantee a smooth running of the course unit.*

There might also be some modules, for example optional subjects or modules in "general studies" if these belong to the curriculum, which do not necessarily be completed at one specific study level or which may be completed at two or three levels. If such forms of flexibility can be allowed, this should be done in order to let students make some choices according to their schedule.

The respective study level (or the possible study levels) of each module must be mentioned in the form for the description of modules.

3.6.1 Division of the programme into study levels

First, the degree programme has to be divided into study levels. A suitable and common division is the academic year.

3.6.2 Prerequisites for entering the next study level

All modules offered in one degree programme have to be related to a specific study level. The prerequisites for modules may be formulated, but should also be put into categories, i.e. modules, in which the prerequisites for a specific module can be attained, should be named. This is not only essential for the smooth running of the course, but it also has special importance when it comes to student exchanges, or further education offers for professionals.

3.6.3 Study level of industrial placements, study periods abroad etc.

As all course units will be related to specific study levels, so will larger elements such as compulsory study abroad periods or industrial placements. This is of great importance for obvious reasons. Before students are integrated into the work or into projects of companies, they must have sound knowledge in engineering and maybe in some aspects of business management. Only if these preconditions are fulfilled, the quality of the training period can be guaranteed.

Furthermore, the companies have a much better opportunity to profit of the integration of students into their business. In study periods abroad, students also have to fulfil certain requirements; these concern, of course, language skills, but also engineering knowledge, in order to make sure that students are able to follow classes in a foreign language, in a foreign environment and possibly with different teaching methods and other focuses in the course.

3.7 Description of Course Structure and Content / Study Regulations

The detailed description of course structure and contents is a very important aspect of curriculum development because of different reasons and must therefore meet certain requirements. When thinking on a concept for course descriptions one should consider the following aspects and target groups.

- *As a consequence of a new perception of learning and knowledge ("life-long learning"), graduates and employers will demand new organisational forms of study opportunities (postgraduate programmes, continuing education, distance* *learning etc.). In a more diversified offer of study courses students need detailed information on all matters concerning their studies.*

- *If student exchanges are to be improved and if more students are to be exchanged between European institutions, partner institutions need comprehensive information of contents, structure, workload, etc. of study programmes at the other institutions. Of course, prospective exchange students also need this information as a preparation for their stay at the host institution.*
- *Student advisors and career services based at the home institution, at other higher education institutions or in other organisations need information in order to advise on study offers.*
- *Very often, students find information on the course, on assessment, administrative matters, etc. in many different documents which could much easier be summarised in one single document which is easier accessible and up-dated regularly.*

3.7.1 Degree / title and career opportunities

The degrees or titles that are awarded after the completion of certain course programmes and the career opportunities students gain with the respective qualification should be explained in detail. This becomes increasingly important the more degrees and certificates are offered. The information should be understandable as well for international students as for people who have not been in touch with higher education so far or for some time.

3.7.2 Learning objectives of the degree programme

The description of the learning objective does not only mean a list of available degrees; a detailed explanation of the qualifications to be acquired should rather be given instead. This also offers students an insight of what is expected from graduate engineers nowadays and thus gives them further orientation on their professional career. Apart from a list of the aspired qualifications, some explanatory notes on the reasons why certain qualifications should be acquired will be helpful and may raise the students' awareness and understanding of the curriculum they undergo.

3.7.3 Course organisation

This section should explain the course organisation and course structure, the division into study levels, the organisation of the time-frame etc. It is recommended to illustrate this information also in a table which shows the individual semesters and what is to be done or what can be done in the respective semesters.

3.7.4 Catalogue of modules per semester

A catalogue of modules has to be offered to students for each semester. The catalogue could be available as a print version, or as a database on the Internet. The latter would allow students from other parts of the country or from foreign countries to check the institution's offer in detail.

3.7.5 Assessment and exams

All matters concerning assessment and exams in the respective course programme(s) need a detailed explanation, for example the assessment methods (written/oral exams, written/oral presentations, projects etc.), how exams are graded, if and how to register for an exam, procedure in the case of illness, failure etc. The principle of continuous assessment should be explained and the reasons for the application of this principle should be given. Thorough advising on these matters helps students to prepare for assessment and to pass successfully.

3.7.6 Study and work abroad opportunities

Some curricula contain international components, such as study or work abroad periods. No matter if the international components are compulsory or optional, the organisation and preparation of these periods must be described in full detail, including names and addresses of supervisors or advisors to ask for further information. Dates when information seminars take place should be mentioned. The institution should make sure that students are aware that study and training periods abroad should be planned at least one year in advance.

3.7.7 Counselling services

All counselling services that are offered by the institution should be mentioned. These might be the Student Counselling Centre, Career Services, International Office, psycho-social counselling, Language Learning Centre as well as counselling hours of teaching staff. The information on these counselling services should mention the tasks of the respective persons or offices and contain the name of contact persons, address, telephone/fax number, e-mail address and office hours. Students should be made aware that making use of counselling services is rather a competency than a lack of knowledge.

3.8 Practical Placements Regulations

One of the main characteristics and core elements of engineering degree programmes at Universities of Applied Sciences is the practical placement. *The placement is not to be seen as a kind of orientation for the professional career (although it also serves this purpose!), but as an integrated part of the curriculum. This requires close co-operation with the employers and the students' supervisors in the companies. Usually, an institution has special staff that is concerned with all administrative and organisational matters of compulsory placements. Teaching staff advises on the contents of the training period.*

Compulsory practical placements may have different characters in the individual European education systems. Formal aspects (study level, duration etc.) as well as aspects concerning the objective and the contents have to be made clear.

Apart from detailed information on the organisation of the training period which is to be given to students as well as to employers, a trilateral contract should be signed by the institution, the employer and the student. The information should have the *character of guidelines or regulations which are binding for all three parties. Some proposals on the documents are given below.*

The institution should define regulations for practical placements in order to make sure that the students reach a certain training goal. Furthermore, it is essential for a better orientation of the student and for a better understanding of the employers and training advisors; in addition, the training period should also be transparent to partner institutions.

3.8.1 Information for students and employers

In order to prepare the placement period, students need information on whether they have to find a placement themselves or who assists them finding a suitable one, how to apply, what to expect etc. Furthermore, information should be given on the opportunities to spend the placement period abroad.

Both, students and employers, need a training plan which illustrates the training objective of placements in individual degree programmes, the contents and the activities. Explanations on how the faculty decides on the recognition or nonrecognition of the placement are essential. Furthermore, information on the classes which accompany the placement should be given.

3.8.2 Guidelines / Regulations

The regulations for practical placements should contain the following aspects:

- **Scope**: Where are the regulations applied and by whom?
- **Objectives and principles:** Close connection between the degree programme and professional practice; students will employ skills and knowledge; becoming familiar with various aspects of internal decisionmaking processes and gaining insights into technical, organisational, economic and social links between operations at the training facility; teach and promote students' capacity for successful conversion of scientific theory and methods
- **Admission:** Student must have reached the specific study level, i.e. he/she must have passed all necessary exams of the study level before
- **Sequence:** When does the practical placement take place (time-frame)? Do students attend a class during that period?
- **Concise training plan:** To be delivered by the respective faculty.
- **Officer in charge for practical placements:** to be nominated by the faculty; should record and approve the required work-places and approve the training contracts.
- **Supervisor:** Each student will have a supervisor from the faculty who is familiar with the field of specialisation.
- **Training contract:** A training contract is signed by the employer, the student and the higher education institution.
- **How to find placements:** The institution assists students to find a placement of their interest. If students find a placement themselves, the institution examines if the placement meets the requirements.
- **Recognition of the placement period:** The placement will be recognised as successfully completed or as not successfully completed. Only if it is successfully

completed, the student will be awarded the credits. The faculty has to decide on regulations when a placement is not successfully completed.

3.8.3 Trilateral contract

The contract to be signed by the employer, the student and the higher education institution should contain regulations on the following issues.

- **General**: Practical placement regulations, concise training plan and an individual training plan are integral components of the contract.
- **Obligations of the contracting parties**: The training facility, the student and the institution of higher education agree to accept certain obligations. These might be, for example, the training facility's obligation to release the student for the class which accompanies the placement or to allow the supervisor of the institution to provide the student with support services, as well as the student's obligation to avail himself to follow the instructions issued to him within the training.
- **Claims for reimbursement of costs and remuneration**: Agreement that training facility may not claim costs incurred within the contract; agreement that remuneration can be agreed on between the training facility and the student
- **Training officer**: Nomination of training officer at the training facility and at the student's faculty.
- **Holidays**: Agreement that holidays are not provided for, just short-term releases.
- **Insurance**: Regulation of insurance matters for the students (subject to national rules).
- **Termination of the contract**: Definition of the rules for early termination of the contract.
- **Number of copies**: Number of copies to be signed.
- **Other agreements**: Special regulations.

3.9 Examination Regulations

The examination regulations cover all aspects concerning the examinations which have to be taken for a specific degree. They may be divided into two parts: a general one which defines the rules for handling exams leading to a certain kind of degree (e.g. a Diplom) and a specific one for each degree programme which determines the specific rules for a certain programme. The regulations have to be seen in association with the credit system applied in the institution.

3.10 Credit Accumulation and Transfer System (CATS)

The implementation of a credit system occurs twice in the description of the modularisation process; the implementation of ECTS is already dealt with in chapter 3.5. There are some reasons for this. Although the objectives of different sorts of credit system are quite similar, they may have a specific focus. For example, the main focus of ECTS is to ease student exchanges between partner institutions. Therefore, it is not only based on credits, it also provides instruments for agreements on study programmes and their recognition and is strongly orientated towards student exchanges between two European higher education institutions. Having these objectives in mind, ECTS can be *seen as a first step towards credit systems. If the options to gain certain qualifications and degrees are to be diversified, a credit accumulation and transfer system as it is known in Great Britain facilitates this process. It is a mixture of a pure accumulation system and a transfer system.*

While credit transfer is a bilateral or multilateral process, credit accumulation is mainly a process taking place within one institution. An employment of accumulation as well as transfer within one system (as it is the objective of credit accumulation and transfer systems) can be enabled through the foundation of consortia as it is practised in Great Britain.

3.11 Grading System

As one of the main principles for modularised curricula is continuous assessment, students will be more motivated to study on a regular basis than they will be in curricula with only intermediate and final exams. Furthermore, students will be informed on their study performance on a regular basis. The grades students receive during their course should be part of the final grade. The certificate for the final degree should list all individual grades which are part of the final grade.

While the credit system refers to the quantity of student workload, the grading system reflects the quality of students' achievements. In order to transfer not only academic credit, but also the achieved grades when it comes to student exchanges, a scale for the conversion of grades into a commonly known grading scale is needed. A facilitating scale for the conversion of credits is offered by ECTS.

3.11.1 Increasing transparency

Documents describing the regulations for study and assessment within the course should also contain information on the principles of the grading scale. The numerical values or the keywords must be explained, and the approximate percentage of students who usually receive a certain grade are a helpful measure to show how achievements in a specific subject area are assessed.

3.11.2 Compatibility with an internationally recognised grading system (e.g. ECTS)

The above mentioned means will help to increase transparency on students' performances for the student himself, for the institutions or for employers, but mainly within the respective country.

3.12 Award System

After the completion of a degree programme, students are awarded a specific degree which documents the achievement of the learning objectives. The degree should not only be known and acknowledged in the home country, but also abroad. Usually, the degrees cannot simply be translated into other languages as they may have different meanings and represent different qualifications. In order to improve the international understanding of the degrees awarded to students, it is essential to make transparent what kind of qualification is attained with a certain degree.

In many European institutions, degree programmes are restructured in order to be able to offer Bachelor and Master programmes which are internationally known qualifications. Very often, these degree programmes are offered in addition to the traditional degree programmes leading, for example, to a Diplom. All degrees must be understandable for students as well as for employers. Therefore, it is helpful to work out equivalencies with other degrees and to draw up a detailed documentation on the degree programme and the institution awarding the degree. It is recommended to use the Diploma Supplement which is going to be used in nearly all European countries.

3.12.1 Degrees and other qualifications

Some examples on course types and degrees attainable in European higher education institutions may illustrate the diversity of qualifications.

- Bachelor of Engineering
- Bachelor of Science
- Diplom (FH)
- Diplom (U)
- Master of Science
- Doctorate
- PhD
- Postgraduate studies
- Supplementary studies
- Complementary studies
- Further / Continuing Education

3.12.2 Diploma Supplement

The European Commission, the Council of Europe and the UNESCO/Cepes proposed in a common initiative to add a so-called "*Diploma Supplement*" to the original certificates and documents certifying final degrees in a standardised form in English language in order to ease the assessment of the respective qualification to foreign higher education institutions as well as to employers.

The supplement shall provide sufficient independent data to improve the international transparency and fair academic and professional recognition of qualifications which are documented as diplomas, degrees, certificates etc. It is designed to provide a standardised description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the student. It should not contain any value judgements, equivalence statements or suggestions about recognition (European Commission).

The *Diploma Supplement* is only valid together with the original documents to which it refers.

It contains:

- information identifying the holder of the qualification,
- information identifying the qualification,
- information on the level of the qualification,
- information on the contents and results gained,
- information on the function of the qualification,

- additional information,
- a certification of the supplement and
- information on the national higher education system which explain the admission requirements, give a general overview of the higher education system and describe the national higher education awards structure.

3.13 Development and Implementation of Quality Assurance and Evaluation Procedures

Quality and quality assurance are issues of increasing importance in the higher education sector. In the context of curriculum development, one may close the circle of activities with evaluation and quality assurance as it is closely connected to the evaluation of the status quo in the beginning of the process (chapter 3.2). When a curriculum has been re-designed, it is important to keep the process of quality assurance running in order to make sure that the learning objectives are appropriate and that the objectives can be achieved with the available resources. Quality assurance includes all measures which must be taken in order to create the confidence of different interest groups, that the qualifications delivered by an institution / a department have the expected standard.

Different methods and instruments can be used for evaluation and quality assurance. One may differentiate between specific approaches to quality assurance (e.g. audit, assessment, accreditation etc.) and quality management systems (e.g. DIN ISO 9001, EFQM etc.). The path to be chosen for quality assurance depends very much on the national education system, the legal framework and the respective requirements. Very often, quality assurance activities consist of self-evaluation activities plus external reviews in which the institutions' own reports form the basis for evaluation.

In a recommendation of the Council of Europe the introduction of quality assurance methods in higher education and the promotion of European co-operation is envisaged. Further information and the recommendation can be found on the server of the European Commission:
http://europa.eu.int/comm/education/socrates/erasmus/ recom.html.

The target of quality assurance is to guarantee that the expectations are met. Quality assurance in higher education can take place on institutional level, on departmental level or also on programme level. In the case of curriculum development, quality assurance activities focus on the programme.

EFQM as an example

J. Degenaar presented the development of the EFQM model for higher education. The EFQM model which traditionally has been a model for companies was modified for the use in higher education institutions and tested in pilot projects in the Netherlands. External auditors were trained in the use of the model.

The EFQM (European Foundation for Quality Management) was developed in 1992 and is a European model for self-appraisal. According to the representative of the Faculty of Technology of the Hanzehogeschool Groningen, the difference of this model, compared to DIN ISO 9000 is that EFQM concentrates on effectiveness and on the question if the organisation is doing the right things while the ISO 9000 series focuses on the arrangement in the organisation, on efficiency, and on the question if the organisation is doing things in the right way.

Nine issues constitute the model:
1. Leadership
2. Policy and Strategy
3. People management
4. Management of resources
5. Management of processes
6. Customer satisfaction
7. People satisfaction
8. Impact on society
9. Business results

While the criteria 1-5 deal with the organisation, the criteria 6-9 focus on the results. The interaction between the results and the organisational criteria are a central issue.

4. FURTHER OPTIONS FOR CURRICULUM DEVELOPMENT

If a curriculum has gone through all the processes described in chapter 3, the result will surely be a thoroughly modernised curriculum on a modular basis which corresponds to the requirements of employers and to the demands of the students. When the objectives of modularisation were discussed earlier, the diversification of education and training options and the development of profession-oriented study programmes have already been named. A modularised curriculum offers a range of options to design special programmes for special interest groups. As students are assessed continuously and as credits are awarded for all modules, there will be more opportunities for part time studies, mobility between institutions, co-operation activities etc.

Usually, one of the reasons for modularisation is internationalisation - internationalisation of higher education in general or internationalisation of curricula in particular. As part of an internationalisation policy, a broad range of activities can be carried out, such as student mobility, teaching staff mobility, international student recruitment, teaching of foreign languages, inclusion of international components into curricula, international research and networking on specific topics etc. In terms of curriculum development there are different options to take internationalisation into account. Some ideas are listed below.

- Compulsory foreign language components in curricula
- Modules offered in a foreign language and / or by a foreign teacher
- Compulsory study periods abroad
- Compulsory training periods abroad
- Modules covering international / European / comparative issues
- Modules offered via distance learning from foreign institutions
- Joint study programmes with partner institutions /double degree programmes
- International degree programmes specially designed for international students
- International degree programmes offered in English for national and international students
- Intensive programmes / projects in international groups
- Thesis preparation abroad
- Etc.

References for the implementation of internationalisation policies and concepts for international activities and their framework conditions can be found in the annex (e.g. Wächter, 2000).

5. EXAMPLE FOR MODULE BASED CURRICULA

European Civil Engineering Management (ECEM) FH OOW, see Fig. 4.

Module	**1st semester**	**2nd semester**	**3rd semester**	**4th semester**
	Level 1		***Level 2***	
1	Mathematics I	Mathematics II	Mathematics III	1sr Industrial Placement **(abroad)**
2	Structural Mechanics I	Structural Mechanics II	Geodetic Surveying	
3	Building Materials I	Soil Mechanics & Foundation I	Soil Mechanics & Foundation II	
4	Computer Science for Construction I	Computer Science for Construction II	Water Building & Water Supply	
5	Construction Engineering I	Construction Engineering II	Construction Engineering III	
6	Environmental Physics	Construction Management I	Construction Management II	
7	2nd Foreign Language	Building Economics I	Building Economics II	
Intensive Week	Technical English I	Technical English II	Excursion	
Module	**5th semester**	**6th semester**	**7th semester**	**8th semester**
	Level 3		***Level 4***	
1	Technical German	Turnkey Projecting I	Turnkey Projecting II	**Diploma Thesis** 2nd Industrial Placement (in home country)
2	Elective I	Elective II	Elective III	
3	Project Management I	Project Management II	Project Management III	
4	Traffic Management	Building Law I	Building Law II	
5	Construction Engineering IV	Construction Engineering V	Construction Engineering VI	
6	Construction Management III	Construction Management IV	Quality Management	
7	Building Economics III	Building Economics IV	Elective IV / Project	
	Excursion	Personnel and Communication	Leadership and Communication	

Figure 4 Curriculum ECEM in Oldenburg at FH OOW
University of Applied Sciences

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Further information : ***Manual of Good Practice as print version and in the website***

http://www.fh-wilhelmshaven.de/aka/modul/

SETTING OF THE ECTS SYSTEM AND SEMESTRIALIZATION AT ESTP

André Morel [1]& Ronan Thiebaut [2]

***ABSTRACT**: ESTP is on of the prestigious French "Grande Écoles", which are the leading institutions in the field of engineering and management education. The setting of the semestrialization and of the European credit transfer system (ECTS) has been introduced at ESTP within the frame of European contract SOCRATES. It allows to increase the exchange of students at European and international level, to facilitate the international acknowledgement of the studies attended at ESTP, to better follow the assimilation of Knowledge by the students. The paper presents the approach adopted in organizing and carrying out the teaching activities, as well as the most relevant results obtained so far.*

1. HISTORICAL BACKGROUND

École Spéciale des Travaux Publics, du Bâtiment et de l'Industrie (ESTP) has a long and prestigious history. Founded in 1891 by Léon Eyrolles, the institution was officially recognized by the State in 1921. Since November 1999, the private, non-profit making association ESTP is associated with another, state-owned, French "Grande École", École Nationale Supérieure d'Arts et Métiers (ENSAM).

In over a century ESTP has trained some 24,000 engineers and 7,000 construction managers and has made its reputation as THE "Grande École" for professionnals in the construction industry.

2. THE "GRANDE ÉCOLE" ESTP

ESTP is one of the prestigious French "Grande Écoles", which are the leading institutions for French engineering and management education. They are accredited by the French minitry of higher education and research and the "Commission des titres d'ingénieur". They award master's level degrees after the "baccalauréat" and five year studies, the first two years in higher education being normally accomplished externally, at the so-called "classes préparatoires aux grandes écoles".

The "grandes écoles" are distinguished by a highly selective admission process, a limited number of students, quality programs, a thorough general education as well as high level scientific knowledge and technical skills, and industrially orientated research activities.

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3. FRENCH INSTITUTE OF TECHNOLOGY

FIT was created in November 1999 when ESTP was officially associated with ENSAM. The aim of both institutions was to thus optimize their present means and broaden the scope of their educational possibilities. Both ENSAM and ESTP are "grandes écoles", which are the leading higher education institutions for French engineering and management.

FIT represents 5000 students, 1500 graduates a year, 500at ESTP in Civil engineering, 13 sites all over France, 460 permanent teaching staff, 1000 part-time teaching staff, holding professional positions in industry, 90 international cooperation agreements and partners all over the world, 38000 practicing alumni, working in all industrial sectors.

4. FORMATION ACTIVITIES

<u>*Construction site managers*</u>

This degree was created in 1933 and awards a two-year specialized technician diploma in two fields, construction manager in building engineering and in civil engineering.

The diploma is recognized by the French ministry of higher education and research at level III. Its objective is to give its holders the theoretical background and technical skills to facilitate their professional integration. The academic calendar is very similar to that of the engineering degree course.

<u>*Engineering degree*</u>

ESTP offers a three-year program, after a two-year "classes préparatoires" course and a selective examination, in four fields :

- building engineering "bâtiment", about two hundred students each year,
- civil engineering "travaux publics", about two hundred students each year,
- topography and surveying "ingénieur géomètre", about thirty students each year,
- mechanical and electrical engineering, about sixty-five students each year.

The same high teaching levels are maintained in each field of study. The goal is to provide both a general education that will prepare the future engineer to become a manager in the international market and a specialized education that will allow him to be operational as soon as he graduates.

Graduates are awarded the "diplôme d'ingénieur", a five year degree that is accredited by the "Commission des titres d'ingénieur" (CTI), and includes the professional accreditation to work as an engineer.

Half of the ESTP students find their first employment while still studying. After a few years of practice, most of them evolve towards management positions.

<u>*Post graduate programs*</u>

Along with the other French "grandes écoles", ESTP offers one-year specialization programs, "mastères spécialisés", for graduate engineers or managers who have already completed a five year degree in higher education or equivalent wok experience. These one-year degree courses are high level and professionally oriented specializations. They comprise, in addition to the lectures, a final thesis that deals with a particular research or problem-solving topic that is proposed by a company and carried out on its premises during the last six months of the training program.

Four courses are offered and supported by French and international construction firms. The subjects are management of construction firms, construction commissioning and contracting and real estate management, facilities management, offshore engineering and naval industrial equipment.

Language and culture for engineers

ESTP offers this summer course in partnership with another French "grande école", EPF-école d'ingénieurs.

The aim was initially to prepare incoming international students of both institutions for their studies in France, but today this course also attracts students, faculty, faculty or administrative staff studying or working in the field of engineering who want to live and study in Paris for a short period during their summer vacation

The emphasis of the program is on solid language training and morning classes are all devoted to language acquisition or improvement. In the afternoon, classes in French culture (art, history, architecture…) alternate with lectures on scientific and technological subjects (French approach to mathematics, mechanics and its fields of application, urban ecology…) or visits (Louvre museum, business center la Défense…).

Successful participants may earn fourteen ECTS credits.

Setting of ECTS system

Recall of the objectives

The setting of the semestrialization and of the European credit transfer system (ECTS) is an obligation as part of the European contract Socrates. It allows increasing the exchange of students at a European and international level, to facilitate the international acknowledgement of the studies attended at
ESTP, to better follow the assimilation of knowledge by the students, and to facilitate the coordination between the classes.

Organization of the teaching activities

The reorganization of the classes implies a uniformization of the times of the different activities in order to optimize the means and to facilitate the intervention of the professionals.

The following new durations are adopted: one and a half hour for the classes, two and a half hours for the applications.

Application of ECTS

The setting of ECTS results in granting credits to each class depending on the workload it requires.

General courses are credited slightly over sixty credits (sixty-three) all together.

Students earns ECTS credits from a teaching activity if:

- for a mandatory or optional class their average in this course is greater or equal to 8/20; they then obtain and ECTS grade between A and E depending on their rank in the class ;
- for the reports on internships, the grade is greater or equal to 12/20;

- for the final overall project (travail de fin d'études TFE), the grade is greater or equal to 12/20.
- At the end of the year, the average is calculated with the obtained grades :
- by weighting the grades of each mandatory class with a coefficient equal to the number of ECTS credits,
- by giving coefficient 1 to the grade of assiduity,
- by giving extra points for the optional classes where the students obtained an average greater than 12/20.
- The following conditions are demanded to enter the upper year :
- obtaining at least sixty ECTS credits with at least fifty-eight from mandatory classes,
- obtaining a general average greater or equal to 12/20.

Conditions for graduation are as follows:

- for first semester classes : obtaining at least forty-two ECTS credits with thirty-nine for mandatory classes, and a general average greater or equal to 12/20 ;
- attending the first year internship;
- attending the second year professional internship and a grade greater or equal to 12/20 for the report ;
- passing the TFE with a grade greater or equal to 12/20, weighting eighteen ECTS credits ;
- fulfilling the requirements on English level.

If they ask, students can take at the most four making-up exams in first year then in second year, three exams in third year, with a priority to uncredited classes. These making up exams are organized at the end of each semester. The grade obtained gives the corresponding credits if it is greater or equal to 5/20, and is considered in the calculation of the general average if is greater than the former average.

5. SEMESTRIALIZATION

Semestrialization has been set since the academic year 2000-2001. The year is divided in two semesters of fifteen effective weeks with a break in early February.

INTERNATIONALIZATION OF THE ENGINEERING EDUCATION AT THE TECHNICAL UNIVERSITY OF CIVIL ENGINEERING BUCHAREST

Iacint Manoliu[1] & Nicoleta Rădulescu[2]

ABSTRACT: *Internationalization is an objective pursued nowadays by many European universities. The paper presents one of the ways followed after 1990 by several Romanian universities offering engineering education in order to enhance internationalization: creation of degree programmes in foreign languages. Three such programmes are in the present offer of the Technical University of Civil Engineering of Bucharest.*

1. THE ROMANIAN ENGINEERING EDUCATION

The Romanian higher education in engineering belongs to the "*continental*" or "*binary*" system present in most European countries and is characterized by the existence of two parallel forms of engineering education: of short duration, with a nominal duration of 3 years, and of long duration, with a nominal duration of 5 years.

The short duration programme leads to an engineering degree equivalent to a Bachelor of Science (B.Sc.) degree from the universities in the countries where the anglo-saxon or two-tier system is present. The programme is intended to educate graduates with know-how in civil engineering and construction engineering technology, able to show an independent judgement within the field of activity and to implement today's knowledge in the construction and exploitation of civil engineering works. A student is granted a degree in engineering (equivalent to a B.Sc. degree) after fulfilling all the course requirements, passing a graduation examination and successfully defending his/her final project.

The long duration programme is an integrated programme leading straight to an engineering degree equivalent to a Master of Science (M.Sc.) degree from the universities in the countries with the two-tier system. The programme is intended to educate graduates with strong knowledge and understanding in mathematics, science and engineering, able to solve complex civil engineering problems and to use the techniques, skills and modern engineering tools necessary for civil engineering practice. *Romania being located in a zone of high seismicity, a strong emphasis is put on Earthquake Engineering education.* A student is granted the degree in engineering (equivalent to a M.Sc. degree) after fulfilling all the course requirements, passing a graduation examination and successfully defending his/her diploma project.

Under certain circumstances, graduates of the short duration programme can continue the engineering education in the long programme.

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Out of the total 53 public universities, 30 include in their offer engineering programmes.

Technical University of Civil Engineering Bucharest, University Politehnica Timişoara, Technical University "Gh. Asachi" Iaşi, Technical University Cluj-Napoca and University "Ovidius" Constantza offer both 5-year programmes and 3-year programmes in civil engineering. The University "Transilvania" Braşov and University of Oradea offer each one 5-year engineering programme in civil engineering.

2. A BRIEF PRESENTATION OF THE TECHNICAL UNIVERSITY OF CIVIL ENGINEERING OF BUCHAREST

Higher education in civil engineering in Romania came into being in 1818 with the School for Land Surveyors founded in Bucharest. In 1867 was established in Bucharest, too, "The School of Bridges, Roads and Mines" transformed in 1888 into "The National School of Bridges and Roads", the first proper technical university of the country. In 1920 "The National School of Bridges and Roads" became "The Polytechnic School of Bucharest", with a Division of Civil Engineering which was named Faculty of Civil Engineering in 1938. As a result of the Education Reform in 1948, the Faculty of Civil Engineering separated from the Polytechnic School and was transformed into an autonomous higher education establishment called "The Civil Engineering Institute Bucharest" which on 1994 adopted the present name: "The Technical University of Civil Engineering Bucharest" (T.U.C.E.B.), the only Romanian university entirely devoted to education in civil engineering and related fields (such as building services, construction machines and equipment, environmental engineering, geodesy).

There are eight academic units at the Technical University of Civil Engineering Bucharest.

Faculties

- Faculty of Civil, Industrial and Agricultural Buildings
- Faculty of Hydrotechnics
- Faculty of Railways, Roads and Bridges
- Faculty of Building Services
- Faculty of Technological Equipment
- Faculty of Geodesy

The six faculties offer long academic training (5 years), providing education in Romanian.

Department of Civil Engineering

The Department of Civil Engineering offers long academic training (5 years) in English and in French in the field of Civil Engineering and only in French in the field of Building Services.

University College of Civil Engineering

The University College of civil engineering offers academic training of short duration (3 years).

The 6 faculties and the Department of Civil Engineering are offering 16 five-year degree programmes in the following fields of study: Civil Engineering, Building

Services, Mechanical Engineering, Geodesy, Engineering Economics and Applied Sciences.

The University College of Civil Engineering is offering 9 three-year degree programmes in the following fields of study: Civil Engineering, Building Services, Mechanical Engineering and Geodesy.

There are two kinds of postgraduate studies in the academic offer of the Technical University of Civil Engineering of Bucharest: the year of advanced studies and the doctorate. The year of advanced studies, concluded with a Diploma of advanced studies, has 20 specializations. The doctorate, concluded with a Doctor of Science in Engineering degree, is organized for 23 specializations.

In the academic year 2000/2001, 7431 students were registered at the Technical University of Civil Engineering of Bucharest.

3. ENGINEERING EDUCATION IN FOREIGN LANGUAGES IN ROMANIA

The two technical universities functioning in Bucharest, the University Politehnica and the Technical University of Civil Engineering were the pioneers in introducing engineering education in foreign languages in Romania. Less than 6 months after the December 1989 Revolution, the Senates of the two institutions decided to introduce 5-year degree programmes with education in English, starting with the academic year 1990/1991. Four such programmes were introduced at the "Politehnica" University (Electrical Engineering and Computers, Mechanical Engineering, Chemical Engineering and Materials Science) and one at T.U.C.E.B. (Civil Engineering).

In the following academic year, the same programmes were also offered in French. In the same year 1991/1992, University "Politehnica" Timişoara and Technical University "Gh. Asachi" Iaşi introduced also engineering programmes in foreign languages, followed by the Technical University Cluj-Napoca and University of Craiova in 1994/1995.

In the academic year 2000/2001, 6 Romanian universities organized 35 degree programmes in foreign languages, from which 17 in English, 10 in French and 8 in German. The distribution of these programmes by fields is: 11 in Electrical Engineering, 8 in Civil Engineering, 6 in Production Engineering, 3 in Mechanical Engineering, 3 in Engineering Economics, 2 in Chemical Engineering and 2 in Materials Science. The total number of students enrolled in these programmes is more than 3.000.

4. ENGINEERING EDUCATION IN FOREIGN LANGUAGES AT THE TECHNICAL UNIVERSITY OF CIVIL ENGINEERING OF BUCHAREST

As already shown, the degree programmes in Civil Engineering were introduced in 1990/1991 (in English) and 1991/1992 (in French). In 1994/1995, a new degree programme was introduced: Building Services (Installations), in French. Including the academic year 2000/2001, the number of graduates of these programmes reached 123 (Civil Engineering in English), 73 (Civil Engineering in French) and 27 (Building Services in French).

4.1 Curricula

Curricula of the three 5-year degree programmes follow the structure of the curricula of degree programmes of the same duration offered for the education in Romanian. In the annex 1 is given, as an example, the curriculum for the 5-year degree programmes in Civil Engineering, identical for both programmes (in English and in French).

4.2 Students recruitment

Degree programmes in foreign languages are open to both Romanian and foreign students.

The admission of Romanian students is a two steps process. The first step is a language proficiency test. Those who pass the test can then compete for the number of places allocated for Romanian students in the respective programme (50 for Civil Engineering in English, 25 for Civil Engineering in French, 25 for Building Services in French), by undertaking a written examination in Mathematics and Physics.

Foreign students are admitted by dossier, after passing the language proficiency test.

4.3 Staff recruitment

Teachers at the Department of Civil Engineering are bilingual subject matter specialists. Most of them are members of the teaching staff of the T.U.C.E.B. Among them there are senior members of the academic staff who in the late 60's-early 70's could benefit of scholarships (Fulbright, DAAD, Humboldt etc.) enabling them to earn degrees abroad or to undertake periods of training/updating. On the other hand, there are younger members of the academic staff who after 1990 completed Ph.D. studies abroad or undertook research and teaching assignments abroad. Occasionally, lectures are also provided by foreign teachers, from universities with which bilateral agreements of cooperation were concluded under the auspices of the Socrates/Erasmus programme.

4.4 Motivation for students

The foreign language use represents a good motivation for Romanian students who realize that they can earn an engineering degree and at the same time enhance their language skills and knowledge. Experience so far proves that there are better chances for mobilities for students of the Department of Civil Engineering. But the major motivation is represented by the better opportunities after graduation. Indeed, most of the graduates face no difficulties in finding good jobs, particularly at the foreign construction or consulting companies operating in Romania.

4.5 Motivation for the university

The foundation of the Department of Civil Engineering brought a strong contribution to the policy of internationalization which is an intrinsic part of the strategic plan of the University. Students exchanges through bilateral agreements and through European programmes such as Tempus and Erasmus were stimulated.

The degree programmes in foreign languages are very helpful in stimulating staff exchanges and in creating new opportunities for young members of the academic staff who successfully completed graduate programmes abroad.

5. THE DOUBLE-DIPLOMA AGREEMENT CONCLUDED BETWEEN ENPC AND T.U.C.E.B.

A double-diploma agreement was concluded on 26 March 2001 between the Technical University of Civil Engineering of Bucharest and Ecole Nationale des Ponts et Chaussées. It is obvious that such development could not have taken place without the existence of the Civil Engineering programme in French at T.U.C.E.B.

The provisions of the agreement are similar with those of the agreements previously concluded by the ENPC with Technical Universities from Berlin, Munich, Madrid, Barcelona and Torino. In the first phase, a number of maximum 5 students from each of the two institutions will be admitted in the programme.

6. CONCLUSIONS

The policy of internationalization is pursued by the Technical University of Civil Engineering of Bucharest on multiple planes. The paper referred to one of those planes, with no doubt the most important one: foundation and development of a special academic unit for engineering education in English and French. In a time of economic difficulties, maintaining three 5-year programmes for a relatively small number of students requires tremendous efforts, but the Technical University of Civil Engineering of Bucharest was able to meet this challenge.

Annex 1

Five-year curriculum in Civil Engineering

First year					
1.1	Analysis I	6	1.10	Analysis II	5
1.2	Linear Algebra and Analitical Geometry I	5	1.11	Linear Algebra and Analytical Geometry	4
1.3	Computer Science	4	1.12	Descriptive Geometry II	2
1.4	Descriptive Geometry I	3	1.13	Physics I	2
1.5	Chemistry	3	1.14	Building Materials	5
1.6	Surveying	5	1.15	Mechanics I	6
1.7	Humanity Courses I	1	1.16	Engineering Graphics I	2
1.8	English or French I	3	1.17	English or French II	3
1.9	Physical education I	-	1.18	Physical Education I	1
		30	1.19	Surveying Practice	2
					30

Five-year curriculum in Civil Engineering (continued)

Second year					
2.1	Advanced Mathematics	5	2.10	Numerical Analysis	3
2.2	Physics II	5	2.11	Engineering Geology	3
2.3	Mechanics II	6	2.12	Strength of Materials II	7
2.4	Engineering Graphics II	2	2.13	Structural Analysis I	7
2.5	Programming languages	3	2.14	Fluid Mechanics I	5
2.6	Strength of Materials I	7	2.15	Architecture & Urban Planning	3
2.7	Humanity Courses II	1	2.16	English or French IV	1
2.8	English or French III	1	2.17	Physical Education II	1
2.9	Physical Education II	-			30
		30			
Third year					
3.1	Structural Analysis II	7	3.8	Reinforced and Prestressed Concrete II	5
3.2	Reinforced and Prestressed Concrete I	7	3.9	Structural Dynamics	5
3.3	Buildings I	6	3.10	Soil Mechanics I	5
3.4	Transport Engineering	2	3.11	Steel Structures I	5
3.5	River Basin Planning	2	3.12	Sanitary Engineering	4
3.6	Technical Field Option 1	3	3.13	Technical Field Option 3	4
3.7	Technical Field Option 2	3	3.14	Field Practice I	2
		30			30
Fourth year					
4.1	Soil Mechanics II	5	4.9	Construction Engineering	5
4.2	Reinforced Concrete Structures I	7	4.10	Foundation Engineering	6
4.3	Earthquake Engineering	5	4.11	Construction Management	5
4.4	Construction Machines	2	4.12	Technical Field Option 3	2
4.5	Enterprise Economics	2	4.13	Technical Field Option 4	5
4.6	Computer Methods in Civil Engineering	2	4.14	Technical Field Option 5	5
4.7	Technical Field Option 1	3	4.15	Field practice II	2
4.8	Technical Field Option 2	3			30
		30			
Fifth year					
5.1	Technical Field Option 6	7	5.7	Diploma Project	30
5.2	Technical Field Option 7	6			
5.3	Technical Field Option 8	6			
5.4	Technical Field Option 9	3			
5.5	Technical Field Option 10	4			
5.6	Technical Field Option 11	4			
		30			

Technical fields

Five technical fields are offered, to which 14 subjects are assigned in the third, fourth and fifth year, totalling 58 credits:

1. Structures
2. Hydraulic Engineering
3. Sanitary and Environmental Engineering
4. Transportation (Railways, Roads, Bridges)
5. Management and Construction Techniques

The list of subjects assigned to the five technical fields are listed in the following table:

Opti-on	Structures	Hydraulic Engineering	Sanitary and Environmental Engineering
1	Elasticity and Plasticity	Elasticity and Plasticity	Elasticity and Plasticity
2	Fluid Mechanics II	Fluid mechanics II	Fluid mechanics II
3	Bridges	Bridges	Bridges
4	Equipment for Buildings I	Groundwater and Seepage	Groundwater Seepage
5	Steel Structures II	Advanced Fluid Mechanics	Water Treatment Engineering
6	Equipment for Buildings II	Hydraulic Transient	Hydraulic Transient
7	Finite Element Method	Hydraulic Machinery and Pumping Stations	Chemistry and Biochemistry of Water
8	Structural Reliability and Risk	Hydrology	Diffusion and Dispession of Pollutants
9	Reinforced Concrete Structures II	Hydraulic Structures	Special Topics in Sanitary Engineering
10	Buildings II	Harbour Engineering	Waste Water Treatment
11	Advanced Steel Design	River Training	Solid Waste Engineering
12	Wood Structures	Land Reclamation and Drainage	Water Pollution Control
13	Advanced Structural Analysis	Water Quality Management	Air Pollution Engineering
14	Non Linear Analysis of Structures	Experimental Hydraulics	Urban and Environmental Analysis

(continued)

Opti- on	Transportation (Railways, Roads, Bridges)	Management and Construction Techniques
1	Elasticity and Plasticity	Methods of Operational Research
2	Fluid Mechanics II	Macroeconomics
3	Bridges	Engineering Law Techniques
4	Transport Equipment I	Public and Private Markets
5	Steel Bridges	Accounting and Financial Control
6	Transport Equipment II	Communication and Defence of Projects
7	Earthworks	Marketing
8	Traffic Engineering	Management of Human Resources
9	Highway Engineering	Construction Management II
10	Reinforced Concrete Bridges	Special Construction Techniques
11	Pavement Design and Performance	Retaining and Underground Works
12	Airport Design	Quality Control in Civil Engineering
13	Tunnel Engineering	Construction Cost Estimating
14	Railroad Design and Construction	Financial Engineering Assembling

PROBLEM/PROJECT BASED LEARNING AT NTNU

Eivind Bratteland[1]

***ABSTRACT**: Under the impulse exerted by the need for changes and adjusments in the study programme at the Faculty of Civil and Environmental Engineering (Norwegian University of Science and Technology), a set of course units called the "PBL-string" was initiated in 1997, in accordance with general trends – both in universities and in industry. The Problem/Project Based Learning (PBL) is focused on the project part, with active use of information and communication technology. It creates improved links between theory and practical applications, and thus the learning environment is greatly enhanced. The paper presents and discusses: the PBL concept and global objectives, re-organisation of course units, teaching objectives, management and resources, ICT utilisation, relation to other subjects, students' assessment, evaluation and a summary of the experience acquired. The PBL courses have already proved their capability to act as a sound platform for further development of civil engineering education process.*

1. INTRODUCTION

The need for changes and adjustments in the study programmes at Faculty of Civil and Environmental Engineering became evident through internal reports at University and Faculty level, as well as by external statements from industry and public management at various levels. A shift from a study period of 4.5 to 5 years provided added opportunity for a re-structuring of the study programmes.

Starting autumn 1997, the Faculty of Civil and Environmental Engineering initiated a set of course units called the "PBL-string". PBL is used as an abbreviation for Problem/Project Based Learning. In this string we use five successive course units running from semester 1 to 5. In our case we use problem-oriented and project-based compulsory units, each covering 1/4 of a semester.

Each class will typically consist of 100 - 150 students. The students are working together in groups of 4 - 5. Two groups are generally sharing a group room, and there are adequate computer facilities available. By a co-operation agreement with the industry, we managed to offer the students a subsidized prize for a standardized portable PC starting from autumn 2000, and around 40% of the students bought their own private, portable PC.

The learning process is focussed on the project part, with active use of information and communication technology (ICT), due attention to the group process and submission of one report from each group. Professional and technical input are given by various means according to need and course layout, including lectures, exercises, reference literature, available information and literature on the Internet etc. The students are put into an active learning environment - learning from each other, and "learning how to learn".

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2. OVER-ALL OBJECTIVES

The PBL-string shall:

- Put the civil engineering subjects in perspective - providing a unified approach, with high quality, clear professional teaching objectives and defined process goals.
- Offer a "new teaching approach", with responsibility for own teaching and training in group- and project work, that will motivate and forward student creativity, and develop attitudes on civil engineering issues.
- Provide an understanding of the broadness of the civil engineering subjects, with special emphasise on application of ICT, understanding of environmental aspects and problems, and general and applicable knowledge on building materials and civil engineering planning and design.

3. THE PBL CONCEPT

The PBL-string is adopted to a more realistic working situation, resembling what the students will face after graduation. The students are collecting and making active use of information to solve the project at hand. The process in the group is important, and improved understanding and use of ICT is a clear goal in the PBL-string.

The PBL concept is not only aiming at new teaching methods for the students, but also at a long-term development of the teaching environment at the Faculty - preferably in close co-operation with the industry. Both the problems to be solved through the projects and the development of co-operative ability should reflect "real world" cases.

The concept can be illustrated as shown in Figure 1.

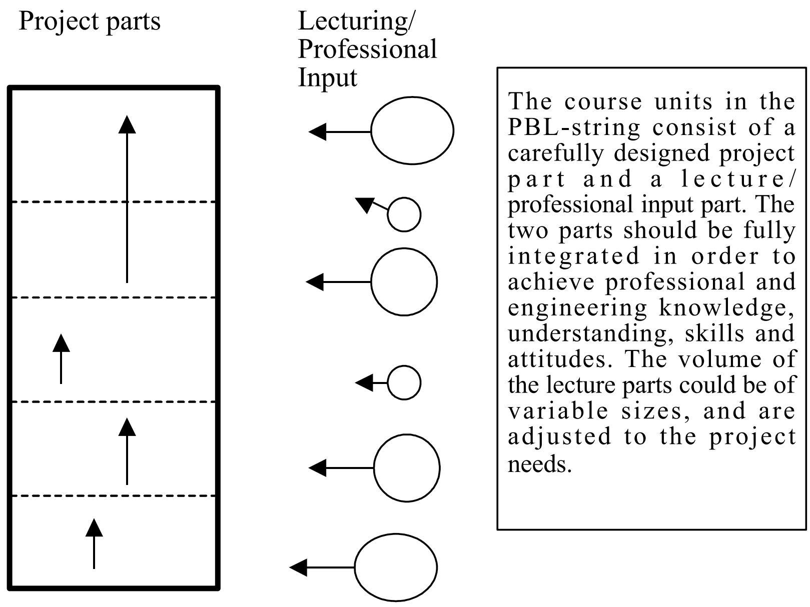

Figure 1 The PBL concept

4. RE-ORGANIZED COURSE UNITS

Some important considerations for a re-organization of the PBL-string, to be implemented from autumn 2001, were:
Quality must be an absolute condition. The PBL-units must be linked to and viewed as an integrated part of the curriculum. The issues/materials learned should be acquired in a logical and natural succession. Subjects that the students learn should be further applied in the near future. Experiences accumulated by the students and the teachers must be given significant weight.

After the re-organization, the PBL course units consist of: [2]

CEE 1:	Physical Planning and the Environments
CEE 2:	Environmental and Resource Engineering
CEE 3:	Building Materials
CEE 4:	Design of Buildings and Infrastructure
CEE 5:	Organization and Economy in Building and Construction Projects

5. TEACHING OBJECTIVES

General teaching objectives:

Teaching objectives for the individual course units shall support and underline the overall teaching objectives of the PBL-string, providing students with:

- Engineering understanding of civil engineering subjects in a comprehensive and society perspective.
- Knowledge, understanding, skills and attitudes within the major civil-engineering related environmental challenges.
- Competence on ICT, and training in broad application of ICT in projects.
- Experience in team work.
- Insight in planning and design of the physical environments.
- Knowledge on building materials.
- Training in civil engineering planning and design.
- Insight in organization, management and economy related to building projects.
- Knowledge and application of major laws, regulations and standards for civil engineering work.

Course unit objectives:

Each of the course units are given specific teaching objectives:

CEE 1: **Physical Planning and the Environments**

The students will get insight into physical planning in an environmental and sustainable development perspective. This include:

- introduction to analysis and planning methods
- introduction to assessments of consequences and methods of comparisons

[2] CEE 1 = Civil and Environmental Engineering 1, First semester, etc.

- overview of the planning system and of the main parts of the law regulating planning and building processes
- insight into environmental issues related to the built environment
- insight into environmental issues related to traffic
- insight into the water supply and discharge systems

CEE 2: **Environmental and Resource Engineering**

The students will achieve an overall and fundamental understanding and practical insight into the major civil engineering challenges related to the environment and use of resources. This include:

- knowledge about global, national and local environmental priorities
- understanding of changes in environmental and resource strategies over time
- understanding of the environment and use of resources in buildings, and technical strategies for improvements
- understanding of use of water resources, development of water pollution and use of water, drainage and waste disposal engineering measures in an adequate and sustainable management of the water resources
- understanding of the priorities in the waste sector and functioning of various systems for waste re-use

CEE 3: **Building Materials**

After the course unit the students will have knowledge on:

- production, compostition and structure of the main building materials
- most important characteristics and demands to building materials related to areas of use and functions in buildings
- relationships between composition, structure and characteristics of building materials and their function in a specific building and a specific environment, as well as joint action between various materials in a structure.

All providing an improved foundation for choice of materials and constructive solutions related to new buildings, rehabilitation and maintenance.

CEE 4: **Design of Buildings and Infrastructure**

The course unit gives practical training in design of various types of buildings and facilities: Buildings, structures, roads and water/discharge facilities. The course unit also gives insight into the most important and relevant aspects and sub-processes related to design. The unit provides improved understanding of individual and societal considerations to be taken in the layout and design of the respective products, as well as technical and economical conditions for the production.

CEE 5: **Organization and Economy in Building and Construction Projects**

The students will understand subjects related to economy and management in a building process. This include:

- understanding of, and basis for, assessment of a budget, know applicable tools for budget work
- carry out a profitability analysis for a building project
- know and make use of tools for project bid calculations
- know the sequences in a contract process
- understanding of the various sub-processes in a building process
- understanding of the various forms of organization in a building process

6. MANAGEMENT AND RESOURCES

Each course unit has a responsible professor. For each project or project part there is a responsible teacher/adviser from the academic staff. Some of the teachers might come from other faculties. Discussions are underway to include more external experts from the industry in this advisory function. A PBL co-ordinator has the overall responsibility for the PBL-string.

To provide a learning environment suitable for a PBL-based teaching, some obvious physical resources must be available. The students must have access to adequate group rooms or areas suitable for group activities. In general this requires more areas than for the traditional lecture and exercise teaching.

The groups must have adequate access to computer facilities. In our case, each group of 4 - 5 students have one computer available in their group room, linked to the Internet.

Particularly in the starting phase of developing a PBL teaching process, the input from the teaching staff will be considerable. However, when gaining experience and developing the students ability to take responsibility and "learn how to learn", the input from the staff is reduced. Normally, several teachers will be involved in each course unit, but they will also work in groups, providing input to only a part of the whole course. Active and resourceful student assistants, in a well designed learning environment, will significantly reduce the needed input by the teachers - without a loss of quality. The student assistants might work with various functions and objectives depending on need. This could include IT, guidance on course subject(s), group process and developments etc.

Human resources involved in the PBL-string are typically 3 - 5 professors for each course unit, and 7 - 9 student assistants.

7. INFORMATION AND COMMUNICATION TECHNOLOGY IN PBL UNITS

The basis for use of information and communication technology (ICT) in the PBL-string is given in a separate course unit in the first semester: Information Technology, basic course.

IT is considered to be a tool - and an important one - requiring focus on application in the various courses and subjects. Our concept is that the students should rather learn a limited number of programmes fairly well, instead of superficially trying out a large number of programmes without the necessary in-depth use. Another important aspect is that the training and application of IT in the PBL-string should support and develop active and improved use of IT in the other course units taught in parallel with the PBL units or at a later stage in the study.

Communications between the students and between student and teacher is generally on the Internet. The students are also submitting their project on the web. In addition to making use of "standard" programme packages, we are for the time being focussing on providing the students with adequate knowledge and application ability on Matlab and Microstation. However, some of the courses make use of other programmes as well, particularly suited to the specific needs in the course project.

8. RELATIONS TO OTHER SUBJECTS

In the re-organization of the PBL-string, strong emphasise was given on the linkages and integration with other course units in the curriculum. To facilitate a best possible outcome, the students must make use of knowledge and skills acquired in other units to solve the PBL-projects. And vice versa: the PBL-units should develop knowledge, understanding, skills and motivation of importance for studying other subjects outside the PBL-units.

This is a delicate and difficult balance, requiring full, continuous attention by students and staff. We believe there are potentials for significant further improvements in this area.

9. STUDENT ASSESSMENT

Assessment and grading of the students are an important and integrated aspect, influencing student activity and input in the course. In general, project evaluation is the main grading criteria. With the subject diversity between the units, it is, however, necessary to have flexibility to make use of other tests/exams when needed. The group have joint responsibility for the work, hence the group normally will be given the same mark. Under special conditions, there must be a possibility for reactions/individual marks, but this should come from initiative taken by the student group.

In general, time used for grading should be reduced and rather used for guidance and student contact during the semester. However, the grading process must be viewed as thoroughly prepared and providing fair results for the students.

The following framework is used for the grading process:

- A main part of the mark should be related to the project. Flexibility in making use of tests/exams can be incorporated, but must clearly be made known to the students at the start of the semester.
- The norm is to give the group the same grade for the project. The group can, under special conditions, ask for exclusion or individual marks for a member from the group.
- An excluded member from a group must submit an individual project.
- Students must in the start of the semester write out a Work Contract, and the students must fill out a logbook during the semester.

10. EVALUATIONS

Since the start in 1997, the PBL-units have been carefully evaluated more or less on a continuous basis, both internally and as part of external evaluation programmes. This has provided invaluable insight and experience, imperative for the development of the PBL-string.

Internal evaluations:

The internal evaluations were linked to and integrated with the formal Faculty bodies. For each unit a reference group were selected by the students. The student assistants and the teachers were included in the process, as was a special pedagogic co-ordinator at the Faculty. Questionnaires were also used for the whole class.

Three main objectives were defined for the internal evaluations within the faculty:

- Provide input for possible corrections of course layout and content, and for the learning environment in the respective course units during the semester.
- Give a basis for improvements in the study offers for the next course.
- Input for conceptual changes in the PBL-string as part of a long-term development.

In addition to results as given in the **Sgfp** [illegible], the evaluations showed that the students were divided in their view on the type of project to be used. Some preferred an open type of problem, while other favoured a more defined problem - asking for specific solutions. Many students have a problem with structuring their own time and work input, hence the start of the course is a crucial point for developing a good study environment. The spread of the student opinions is - not surprisingly - significant, underlining the need for very careful analysis and assessment before using these as a basis for measures and actions.

Evaluation project Digitalis:

Digitalis was an umbrella-organization for external evaluation of many individual projects - the PBL-string being one of them. The evaluation was based on:

- Questionnaires
- Interviews with leaders of faculty and departments, staff, student assistants and students
- Observations during participating meeting
- Assessment of available documentation

Some of the main results from the evaluation of a first semester IT basic course - including a project work with application of IT in designing a building involving a broad specter of civil engineering aspects, can be summarized as follows:

- Students are in general positive to the educational method
- The marks for the PBL-based IT basic course was comparable to the standard courses given to other faculties
- The PBL-project related to an actual case, and gave the students a feeling of the future. This provided increased motivation
- An adequate relation between theory and practical application was achieved
- The students divided the work among themselves to a larger degree than what should be done according to the PBL-intentions

The E-book project:

The E-book concept uses formative evaluation for a continuous, spontaneous evaluation of developing processes where reflections and conceptualizations are leading to measures relative to the process. Results are used as a basis for modelling and design of the next phase in the process or of the next project. This concept is inspired of and related to the development of "*total quality management*". The tool is a databased system enabling spontaneous observations and evaluation of many activities from a sizeable number of individuals (students).

The E-book project were aiming at providing useful information and input to:

- *Evaluation group*: for proactive functions, quality monitoring and control, continuous evaluation, strongly reduced reaction time for needed adjustments, more effective course unit evaluation.
- *Students*: better study organization, improved influence on his/her own study situation.
- *Teacher/supervisor*: continuous information, improved possibilities for dialogue and actions, basis for changes and improvements in the short and long term.
- *Development of teaching*: Improve competence on and ability to change student learning environment and activities at the faculty (university).
- *University, ministry*: developing criteria for learning assessment, and relative comparisons in an actual teaching situation.

A pilot project started in the autumn 1999, gaining experience with the databased system. The project includes also PBL course units. It is still running and useful information collected.

11. SUMMARY OF EXPERIENCES

In the re-structuring of the PBL-string, experiences from the previous courses as documented from the implemented evaluation processes were given high priority as a basis for further development. Important experiences can be summarized as follows:

- All PBL-units must have common criteria and characteristics for the practical implementation (without loosing the integrity and individual characteristics for each unit).
- Well defined teaching objectives are extremely important.
- Emphasise on continuity and progression - avoid overlapping.
- Secure and follow up the time used on the subjects (time norms should be adhered to - in our case 1/4 of a semester).
- Concentrated lecture series should be considered in the starting phase, to facilitate a more effective start of the project work.
- More use of external lectures from the industry is beneficial, high-lighting practical approaches and considerations.
- The project works should, if at all possible, make use of real, ongoing cases. Considerable added value if the cases are close by, providing opportunity for easy excursions and investigations.
- Extremely important to secure that the whole student group is working together on the project - fragmentation of the work into independent parts must be avoided.
- Training in team work and internal student agreements must be emphasized.
- Guidance and supervision is challenging, and requires understanding and attention from all parties involved.
- Evaluation systems must be designed to support and forward the wanted study form and progression.
- Introduction of a "*one day per subject - concept*" should be considered. This will provide more effective work and facilitate a better learning environment.

12. CONCLUSIONS

1. Careful internal and external evaluations have documented that the strategic objective of the introduction of a PBL-string at the Faculty of Civil and Environmental Engineering has proven to be valid and successful.
2. The introduction of the PBL-string is in accordance with general trends - both at Universities and in the industry.
3. The PBL-courses give improved linkages between theory and practical applications, and improved possibilities for use of theories.
4. Students are supporting the PBL-concept, and the learning environment is improved.
5. The PBL-courses provide a sound platform for further development of the Faculty study offers.

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EXPERTS IN TEAM
An Interdisciplinary Course Unit at NTNU

Eivind Bratteland[1]

***ABSTRACT**: In order to make the students more aware of their future role as team-players able to solve multi- and/or interdisciplinary problems, the Norwegian University of Science and Technology decided in 1999 to introduce Experts in Team (EiT) as a new compulsory course. The main objective consists in developing students' attitudes and skills in working together in a problem solving work team including members specialised in different areas of expertise. The work is organised in "villages" on a one day/week basis and the University provides the necessary infrastructure and assistance. Companies, trade associations, research institutes, public authorities participate as "external principal employers" in the advisory function of the village and are also active in providing actual and realistic problems of interest for the industry. The reults obtained in the spring semester 2001 are presented and commented, emphasizing the importance of feedback and input for further development provided by an extensive evaluation scheme.*

1. INTRODUCTION

A comprehensive committee work back in 1993 (with participation from the industry) included a broad assessment of necessary and relevant competence for the future engineers. One recommendation was to make the students more aware of their future role as team-players, solving multi-and/or inter-disciplinary problems. The students should achieve skills in team-work with participants representing various background - from engineering or other fields. The best time for this new course was considered to be the 8th semester.

The introduction of a new 5-year curriculum in the engineering studies (starting from 1997) provided the University with a feasible opportunity, and NTNU decided to introduce Experts in Team (EiT) as a new compulsory course for all engineering students. The course unit should train the students through a problem-oriented and project-based approach, with group participants coming from various faculties or study areas. EiT is given in the 8th semester, and offered on a full scale for the first time in the spring semester 2001.

2. OBJECTIVES

Through working on the project, the student shall develop attitudes and skills in working together in a problem solving work team, where the members are specialised in different areas of expertise, and have different ways of approaching and solving problems.

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The student shall through a challenging problem acquire knowledge within his/her area of expertise, while also learning that taking responsibility for his/her part of the problem adds to solving the team's common task.

3. CONCEPT AND ORGANIZATION

The concept chosen for this model is:

- The student team is the main resource. The students are defining their specific task within the overall project subject. They are also responsible for the organization and management of the village. Focus is not on the professors.
- Each village can have up to nine student groups, four students each. Each group is working with a selected sub-problem within the overall project. A typical village size is 20 - 36 students.
- Each village has a responsible "village professor". In addition up to four student assistants are allocated to each village, providing support for the team process. Professional support and advice is given from the academic staff at the faculties and from external resource persons. All these advisers should act as facilitators.
- Industry and other relevant organizations are invited to propose problems for the villages to work on, and to participate in the advisory function. The university offers the student groups as a resource.
- One day every week during the 8th semester (Wednesdays) will be allocated to project work only. The semester covers 14 weeks.

Figure 1 shows the village, with students as the main resource and the external "principal employer" and the university as support.

The University provides the necessary infrastructure and assistance for the work: rooms and computer facilities; advisory functions through a "village professor" and other advisory/supervising personnel including student assistants (facilitating functions).

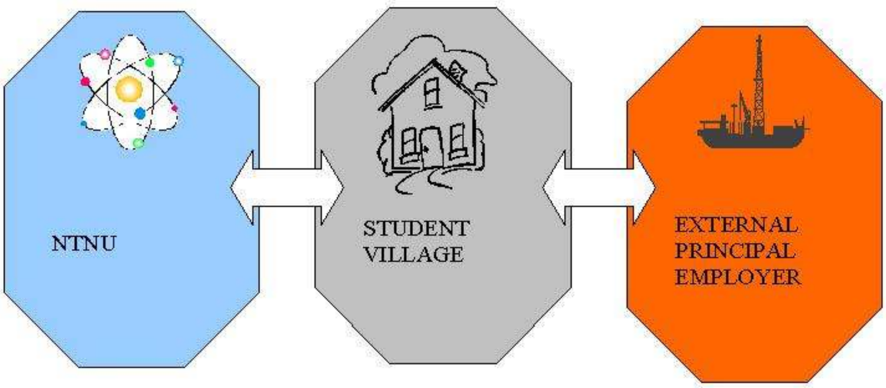

Figure 1 Expert in Team Concept (Ref 1)

4. EXTERNAL PARTICIPATION

Invitations go out to companies, trade associations, research institutes and/or -programmes, public authorities, NGO's, etc for participating as "external principal employers". Each village should, if at all possible, have 1 - 3 external partners. This provides a unique opportunity for contact with future graduates. In addition, most villages will have individual external resource persons willing to act as advisors in their respective fields.

External participants should participate in the advisory (facilitating) function of the village, and should preferably participate in the main meetings in the village. The external participants should also be active in providing actual and realistic problems of interest for the industry. The tasks given should have an interdisciplinary character, where a solution (method, product etc) is needed, and which will be appealing to the creativity of the students.

5. IMPORTANT COMMON BASIS

Before starting the full-scale course, two pilot tests were run in spring 1999 (4 student groups) and in spring 2000 (10 student groups). This provided invaluable experiences and facilitated a "bottom-up" development. The pilot tests were imperative for a successful design of the course, and for creating interest among the students and our external partners.

Communications within the groups, in the villages and for the total EiT were through the system: Basic Support for Cooperative Work (BSCW).

The pilot tests resulted in 8th "posters" summarizing the common basis for the full-scale Expert in Team course. Some of the main issues were:

- The project: Interdisciplinary, requiring input from at least 2 different study programmes. Generally addressing an "open problem", and requiring 1/4 of a semester input.
- Teaching objectives: Two objectives; one dealing with the process, developing attitudes and skills in team work, and one dealing with professional objectives, fostering knowledge and integrated solutions.
- Evaluation of results: Each group gets the same grade based on the following: Professional report - 50 %, presentation of the work in plenum with external sensor present - 25 %, assessment of the team process based on observations and a process report - 25 %.
- Advisory functions: Professional advice and supervision on the project in the starting- and implementation phase. Advice on process. Advice and supervision on specific subjects (e.g IT, literature search, report writing etc). The village professor has the overall responsibility and is the co-ordinator for all activities.
- Starting phase: Village professors and student assistants are offered a course in team processes before the start. The students are given adequate information on main objectives, teaching objectives, level of ambition, exams, and various practical information (communication, milestones, meetings, work contract, etc). This is all related to the overall framework, while the students themselves "run" the village.

- Implementation phase: Professional milestones and advisory functions, plenum meetings (every week, compulsory), team process including reflections and handling of tentative problems.

6. THE VILLAGES

The Expert in Team course unit for spring 2001 resulted in 32 villages with a total of 690 students. A few examples to illustrate the broad range of subjects addressed:

- How to get 10% more oil out of the Gullfaks field?
- The cellular phone glove.
- Processing of marine raw materials - utilization of bio-products.
- Technology for medical and environmental monitoring.
- Information and communication technology and the virtual space.
- Deep water technology - risers and moorings.

At the Faculty of Civil and Environmental Engineering 142 students were participating in 6 villages:

- Aluminum structures.
- Coastal development - 2015.
- Company improvement potential in an industrial - ecological perspective.
- Energy- and environmental effective buildings.
- Northern detour road in Trondheim - planning and construction.
- Waste water as a resource.

7. COASTAL DEVELOPMENT - 2015

The village on Coastal Development - 2015 (CD village) had 19 students, coming from the following faculties:

- Faculty of Civil and Environmental Engineering 7
- Faculty of Physics, Informatics and Mathematics (Data) 3
- Faculty of Applied Earth Sciences 1
- Faculty of Chemistry and Biology 2
- Faculty of Marine Technology 4
- Faculty of Social Sciences and Technology Management 1
- Foreign exchange student 1

The five groups in the Coastal Development village choose the following subjects for their work:

1. Developments in a coastal community - Industrial development in Vikna.
2. The Eiksund road connection - influence on industry.
3. Feed production challenges for fish farming towards 2015.
4. Cultivation of common mussels at Hitra.
5. Priority on renewable energy - assessment of various energy-sources on the coast.

8. EVALUATION AND EXPERIENCES

The EiT course unit is one of four units in the semester. Generally, the experience from project activities indicate that the students frequently spend more time on these type of studies than originally allocated. This might in turn have negative effect on the other parallell courses. Table 1 shows the hours per week that the students used on EiT, for all villages, and for the Coastal Development Village.

Allocated time according to plans should be 12 hours per week. For the Coastal Development village, it was clearly indicated to the students from the very start that they should aim at this number in their work. At the time of the survey (after 11 weeks), more than 60% used 10 - 14 hours per week. When including the last three weeks of the project, the results would probably have shifted somewhat towards right, spending more time. The spread for all villages is higher, and a small percentage (3%) actually spend more than 20 hours a week on this course.

Evaluations on various aspects were given high priority throughout the course. Village professors gave their opinions after finalizing the course. Some of the results are given in Tables 2 - 5, and are commented on in the following.

Table 1 Hours per week spent on EiT course unit. (Student assessment after 11 weeks.)

	Percent distribution of hours/week				
	< 5	5 - 9	10-14	15-19	> 20
Total - all villages (564 responses - 82 %)	3	34	48	12	3
Coastal Development Village (17 responses - 89 %)		24	62	15	

Table 2 shows - as might be expected - that the spread for all villages are larger than for the CD village. Planning and efforts made before the course start is extremely important, and seems to have given a good initiating process of the course. For the CD village the results indicated a very successful initiation of the project, also clearly influenced by a visit to a coastal community in the start to get information on and a feeling for local problem areas. The CD village also had two very positive and involved student assistants providing adequate and supportive assistance to the students.

Table 3 demonstrates that, in general, the groups were given the possibility to define their work themselves. This was particularly the case for the CD village. On the other hand, large freedom can easily result in choosing a project that might not foster a strong interdisciplinary co-operation. The internal communication was generally assessed to be good. Within the CD village more than 80% considered the communication to be at level 7 or above. Student assistants (SA) were still assessed to be important for the team process. 12% of the participants in CD considered SA to be of no importance, while the rest found them to be important to very important. The low score on use of external partners for CD is not quite representative, as the village had considerable external contact but with people outside the external principal partners.

On an individual basis, main results are shown in Table 4. One of the intentions with the EiT was to have the students acting as "experts" in the groups. This has only partly been fulfilled for the villages. For the CD village, it has hardly been any "expert" function. This was related to the fact that the students choose general types of projects where all of them had an interest, but none had specific professional background. Students in the CD village were quite aware of their responsibilities and demonstrated a willingness to participate in meetings.

Table 2 Student Assessments of the Starting Phase (after 5 weeks)

Questions		Percent distribution on a scale 1 - 9 [1)]								
		1	2	3	4	5	6	7	8	9
The start was clear/orderly and with good information	Total	4	10	13	11	11	14	20	13	4
	CD				11	5	16	32	26	11
The project work of the group is a good starting point for interdisciplinary co-operation	Total	3	8	11	12	13	16	19	13	6
	CD	5	5	16	11	16	21	26		
The village professor has been easy to contact,and provided adequate support	Total	1	3	5	6	17	13	21	19	14
	CD	5				21	16	21	16	21
The project team has been given good support in defining the project	Total	7	14	17	11	12	16	13	6	3
	CD	5	5	21	16	11	16	16	5	5
The student assistants have been able to display the process in the team	Total	10	15	16	13	15	12	11	6	1
	CD			11		5	16	32	37	

[1)] Scale from 1 - 9 denotes:1: (-)/little/disagree. 9: (+)/much/ agree.

Total: Response from 542 students (79%).

CD: Response from Village on Coastal Development, 17 students (90%).

Table 3 Student Assessments on Group Activities (after 11 weeks)

Questions		Percent distribution on a scale 1 - 9 [1]								
		1	2	3	4	5	6	7	8	9
Did the group have freedom to define the task according to own wishes?	Total	3	5	6	2	5	6	16	22	36
	CD							6	18	76
Did the group issue provide good opportunity for interdisciplinary co-operation?	Total	8	10	18	9	15	9	14	12	5
	CD	24	18	41	6	6	6			
Was the contacts with the other groups in the village useful?	Total	14	18	16	9	11	10	12	6	4
	CD	12	6	29	6	12	24	6	6	
Was internal communication characterised by willingness to listen and open-mindedness in response?	Total	1	2	4	6	7	14	22	27	18
	CD				12	6		35	29	18
Were the students assistants able to display the team process?	Total	10	12	15	10	15	14	14	7	2
	CD	12				6	24	35	12	12
Did the group make active use of the external partners?	Total	20	17	15	10	10	9	5	3	12
	CD	15	31	38	15					

[1] Scale from 1 - 9 denotes: 1: (-)/little/less/no importance. 9: (+)/much/more/very important.

Total: Response from 564 students (82%).

CD: Response from Village on Coastal Development, 17 students (90%).

Table 4 Student Assessments on Individual Aspects (after 11 weeks)

Questions		Percent distribution on a scale 1 - 9 [1)]								
		1	2	3	4	5	6	7	8	9
Have you developed knowledge within your own field?	Total	25	12	13	7	7	12	15	6	2
	CD	59	35					6		
Have you participated in presentations and discussions at the village meetings?	Total	3	4	5	5	13	18	24	18	9
	CD	12	6	6	6	6	12	24	24	6
Do you think it is the responsibility of the students to contribute constructively in the village meetings?	Total	7	2	6	5	16	17	24	15	8
	CD					18		47	24	12
Have you improved your understanding on how an inter-disciplinary team should co-operate?	Total	8	11	11	8	13	17	17	12	4
	CD	12	6	24	18	18	12	6	6	

[1)] Scale from 1 - 9 denotes: 1: (-)/little/less/no importance. 9: (+)/much/more/very important.

Total: Response from 564 students (82%).

CD: Response from Village on Coastal Development, 17 students (90%).

Evaluations by the village professors are shown in Table 5. The professors assessed that to start this course for developing the skills in inter-disciplinary understanding and ability as well as team work training were important but not very important. Both the professional and the process part is considered to be important, and the current EiT is able to a reasonable degree to meet with the objectives of the course. Existing degree of freedom to choose is by and large assessed to be reasonable, and the professor thought the motivation aspect of the course was good. Around 60% thought the ambition level was well adopted and adequate. The ability of the project to trigger professional integration and co-operation gave a large spread in answers, with the majority on the positive side.

Table 5 Evaluations made by the "Village Professors"

Questions	Percent distribution on a scale 1 - 9 [1)]								
	1	2	3	4	5	6	7	8	9
How important is it that the education starts to develop these skills?	4		4	8	42	13	2	5	
How important is the professional part?	4	4	4	4		4	16	32	36
How important is the process part?				12	12	8	16	24	28
Is the current EiT able to meet the set objectives		4	4	12	8	13	42	8	8
Should the balance between a common platform and freedom to choose be more within a fixed framework (1) or have even more freedom (9)	4		4	8	42	12	8	21	
Did the project trigger professional integration and co-operation?		15	6	9	9	21	12	18	9
Did the course unit provide student motivation?		7			13	30	17	27	7
Did the project have a suitable ambition level?		4	4	11	15	7		44	15

[1)] Scale from 1 - 9 denotes: 1: (-)/little/no importance. 9: (+)/much/very important.
Results based on response from 25 "village professors after the course.

Feedback on the Coastal Development village showed that around 50% were quite satisfied with the professional part, while 50% said the focus on the team process was successful. The freedom to choose the project was appreciated, on the other hand some stated that more defined and limited project would be beneficial. The professional outcome was particularly related to learning something new and different from their traditional studies, they improved the ability to access information, and appreciated the training to work together with people they had never seen before. The projects did, however, not provide the opportunity to act as an "expert", and some thought the process was given too much focus relative to the professional activity and output. The students showed responsibility and motivation, the groups had good progression in their work, and in general they succeeded reasonably well in distributing the work within the group members. Suggestions for further development of the course included: Changes in group selection (this time the groups were fixed beforehand); more clearly defined tasks, and more focus on professional supervision; select a project that is linked to an actual case, where the groups solve one part of the problem; more emphasize on the "expert" role, where the students can make use of their respective professional background, knowledge and skills.

9. CONCLUSIONS

The new large-scale course unit in Experts in Team was carried out with successful results in the spring semester 2001. Some 690 engineering students participated in 32 villages. An extensive evaluation scheme provided invaluable feedback and input for further development of the course, resulting in the following conclusions:

1. Student response to EiT was generally favourable.
2. The village professors were by and large positive to the new teaching approach.
3. A well defined concept, and a common basis on organization and implementation defined before the start of the course was extremely important for a successful outcome of the EiT course unit.
4. The use of student assistants was imperative for the results, and external partners and advisors provided extremely important linkages to the "real world".
5. Careful and well designed evaluations provide a basis for development and needed changes in future courses.
6. Within the overall framework, reasonable flexibility should be given to the individual villages.
7. Basic Support for Cooperative Work (BSCW) proved to be a useful and applicable tool for team cooperation and contact.
8. There is clearly a delicate balance between freedom to choose and a more directing approach in defining team projects, enabling the students to have a higher degree of "expert" role.

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USING INFORMATION TECHNOLOGY IN TEACHING AND LEARNING OF STRUCTURAL ENGINEERING

Matej Fischinger[1] & Tatjana Isaković[2]

ABSTRACT*: Teaching and learning of structural engineering has to be redesigned. The project-based, experienced-based and team oriented teaching and learning should be introduced. These new ways of teaching can be enhanced by using different capabilities of information technology. The problems and possible solutions in redesign of teaching and learning in structural engineering are summarized in the paper. Some case studies performed at the University of Ljubljana are presented in some detail.*

1. INTRODUCTION

In recent years it has been realized that information technology (IT) is a very efficient tool, which can enforce and enhance the needed redesign of university (structural/ civil) engineering education. IT can be used to solve several major problems in teaching structural (civil) engineering:

- to replace outdated instructor-centered lecturing by more adequate and more efficient student-centered teaching and learning (problem-based, project-based, case-based, and team oriented),
- to give students more knowledge about "real-life" problems, and to introduce them to a collaborative work with different kind of professionals (e. g. architects and construction engineers), which they will meet in a "real-life",
- to give students more flexibility regarding time and place of learning,
- to present complex analytical and design procedures in more understandable and clear way,
- to present widespread experience-based knowledge, which structural engineering is based on.

These problems are briefly described in the first section of the paper. The second section includes a review of possible IT based solutions. In the third part of the paper three case studies made at the University of Ljubljana are presented.

2. PROBLEMS

Many teachers, students and researchers agree that ***traditional instructor-centered lecturing*** is in many aspects outdated (e.g. Davis 98, Schank and Cleary 94). They emphasize that this type of teaching does not encourage students' creativity and does not give students enough knowledge of the "real-life" problems. This is particularly evident when analyzing different courses in university teaching of various topics in civil engineering. Usually, there is a large distinction between courses in the first and the last two years of study. In the first two years lectures are usually organized

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in a traditional way. Students usually find such lessons less interesting, many of students are disenchanted, overwhelmed or lost in the shuffle (Davis 98, Bieron and Dinan). This is one of the main reasons causing a large number of students leaving the study of civil engineering (Manoliu and Bugnariu 01). Contrary to the first two years, courses in the second two years of study are more ***project and problem oriented***. There are many cases where students are involved into a team-work and where ***"real-life" problems*** are solved. Study is more ***student-oriented***, therefore students usually give enthusiastic reviews about these courses, citing the hands-on projects and creative stimulation.

To make the process of learning more student-oriented, it is also necessary to give a student more freedom to choose when and how to learn. A possible solution is to organize ***distance learning***. The distance learning can be combined with a ***team-work***. A civil (structural) engineering is a profession, which is strongly linked with other professions, for example architecture and construction engineering. To reach the final goal to build a building or bridge, many specialists have to collaborate. Communication misunderstanding, coordination, late conflict identification and resolution among A/S/C (architecture/structural/construction engineering) professionals is emphasized by divergent education (Fruchter 96a). One of the solutions of this problem is collaborative, team-based learning of students from different departments. In this case there are several teachers involved in the course. It has been found (Fruchter 96a) very useful that some of the teachers are experience practitioners, since the experiences have a very important role in the every day design.

It could be concluded that in civil engineering the ***experience-based knowledge*** is as important as the traditionally structured knowledge, which is usually presented to the students. Experience-based knowledge is based on feelings, it is descriptive and it is difficult to present in a traditional way. The solution can be obtained using IT.

3. SOLUTIONS

Although the above mentioned new ways of teaching can be also implemented in the traditional way, it is easier and more efficient if various IT tools are used in the process of the redesign of structural engineering education.

In civil engineering and architecture the predominant way of sharing information is graphical. Today it is very common to prepare design plans using computers. Computer programs, like Autocad for example, are nothing exotic in every day practice. However, the use of computer graphics is not limited just on preparing 2D plans of a building or a bridge. Combined with the text and sound, including animations, it is used for very useful presentations of even more demanding information than plans of a building. There are many reports, where different attempts of using multimedia for enhancing the teaching process are presented. Two of them (Angelides et al. 00, Soh and Gupta 00) could be underlined, since they involve good summary of different projects using multimedia in engineering education.

The use of the multimedia enables ***more understandable and clear way*** of information presentation. However, a multimedia can be used in very different ways. Efficiency of different media is compared in a case study in (Lee et al. 01).

Combining the multimedia components with some other IT elements (e.g. Internet) and organizing data in databases, very efficient teaching tools can be made (Fischinger et al. 98, Madrazo and Weder 01). An example is presented in the case study B in this paper. Such tools can successfully present very demanding information as e.g. ***experience-based knowledge*** is. Moreover, they are a very good solution when the teaching is organized in the form of ***distance learning***. Student can exam the problem in different perspectives. The way how to learn and the schedule is not prescribed. Each student can decide how to learn, according to his/her preferences. In such a way the main goal is reached: learning becomes more creative.

However, the ***distance learning*** is a quite complex process. Therefore, previously described tools are far from being self-sufficient. They can be only a part of a larger system, where additional IT tools have to be incorporated. The video-conferencing, e-mail, white boards, chat rooms, etc. are also necessary to form student-friendly and student-centered environment. To be efficient the system of distance learning has to be planned very carefully. An excellent handbook how to organize and manage such courses using IT tools is described in Chute at al. 99. The authors gave an overview of the major distance learning technologies in use today: audio teleconferencing, audiographics, video teleconferencing, computer based training, computer conferencing, electronic performance support systems, and education and training on the Internet.

Today technology enables the ***team-work***, which can be combined with ***distance learning and distance teaching***. Several very complex attempts were made to organize the multiuser virtual workspaces for collaborative design. In (Rosenman and Wang 01), it is discussed how a collaborative CAD system supporting virtual product development could be organized. An excellent overview of previous research is presented. The possible architecture of such a complex system has been proposed. In some other papers (Woo et al. 01, Kaga et al. 01) virtual studios and virtual design offices are presented. These attempts are limited to collaboration between students or practitioners of one profession. In most of these systems data are organized and published on the web using "web oriented database systems". An example of such system is presented in case study C in this paper.

The most complex virtual classroom or virtual design office seems to be that, which have been developed for years at the University of Stanford (Fruchter 01). The project named PBL (problem, project, product, process, people based learning) is supported by internet mediated design communication, integration and organization of the frameworks, groupware technology and multimedia. A complete description of the system organization and the used IT tools can be found in (Fruchter 01 and Fruchter 96b). The work is ***team-based, project and problem based***, collaborative, multi-professional and multinational. Each team includes one student of architecture, structural and construction engineering. Students are coming from different universities, countries and continents (including University of Ljubljana). Teams solve ***"real-life"*** problems. Lecturers are faculty as well as industry members. Therefore, both traditionally structured and ***experience-based knowledge*** are available to students.

A project, described in the previous paragraph was used as a model for a similar course at the University of Ljubljana, which has been recently introduced (see case study A). However, organization of the course and the experiences are still very limited. This course and some accompanying case studies at the University of Ljubljana are described in the following sections.

4. CASE STUDY A: A TRIAL COURSE "IT SUPPORTED STRUCTURAL ENGINEERING"

A trial course "*IT supported structural engineering*" has been recently introduced at the University of Ljubljana. The sample model for this course has been PBL project, described in the previous section.

In the frame of this trial course three teams, each involving one student of architecture and one student of structural engineering were formed. The work was project and problem oriented. Each group had a task to design a "real-life" structure: shopping center, hotel and public parking house. A floor plan of the public parking house is presented in Figure 1. Several teachers and tutors, who were experts of very different profiles, were involved in the project.

The work on projects was organized in five main steps: 1) architect proposed basic geometry of buildings based on the project requests, 2) structural engineer proposed several basic structural solutions, 3) structural engineer and architect negotiate and chose the optimal solution through collaborative work, 4) both made the detailed analysis from different perspectives, 5) together, they prepared the presentation of the project.

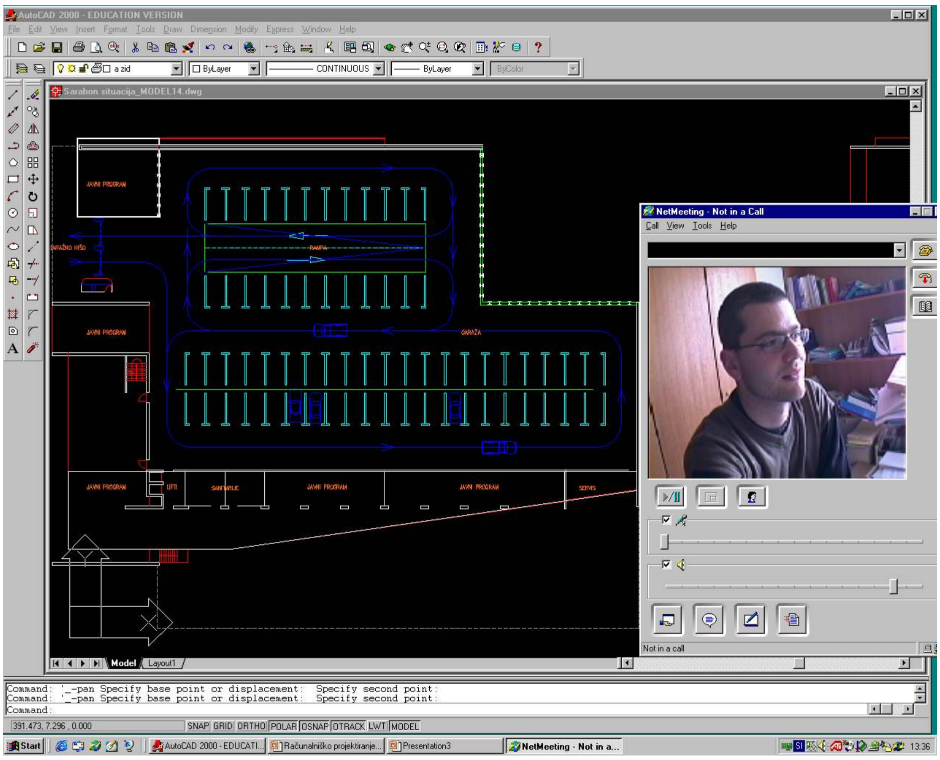

Figure 1 A floor-plan of a public parking house

Since the faculties of civil engineering and architecture are dislocated, collaboration was organized using various IT equipments. All students had access to the central server, where complete information about projects was stored. The AutoCAD was used for graphic presentation of buildings. Analysis of buildings was performed by standard programs for structural analysis. For collaboration web pages and e-mails were used. Once a week face-to-face meetings through videoconferencing were organized. Tools using ftp protocol were also used to share data.

Based on very limited experiences obtained from this trial course, it can be concluded: 1) at the beginning, most of the students were not experienced using different IT equipments, however they learn to use this tools in a very short time, without larger difficulties, 2) students were faced with the "real-life" design, 3) they were forced to think about the complete structure and not only about several parts, 4) they had to take into account request from other profession, when designing a building, 5) for the first time they could experience a multi-professional team work, 6) the collaborative work of students of architecture and structural engineering was quite successful.

5. CASE STUDY B: A TOOL TO COMMUNICATE EMPIRICALLY BASED KNOWLEDGE IN EARTHQUAKE ENGINEERING

The current procedures in earthquake resistant design have been developed during an evolutionary process based on the observed behaviour during strong earthquakes. Modern IT provides an excellent opportunity to disseminate such empirical knowledge. As an example, the presented earthquake engineering slide information system EASY (Fischinger et al., 1997, 1998) was developed.

EASY is a hypermedia tool based on digital slides to learn from post-earthquake investigations. The core of the tool consists of 500 digital images showing earthquake damage after recent major earthquakes. While many databases with earthquake related images exist on the Web, extensive commentaries are probably the most distinguished feature of the EASY. They include short captions, detailed global descriptions and general descriptions of different causes of failure. Links to related slides and information are also provided. The system offers state-of-the art navigation, browse and search options using a combination of database technology and friendly Web hypertext interface. The system is available on the Web and on the CD-ROM.

The most typical information required by the majority of users would probably be the explanation of the cause of structural failure. Browsing option offers the simplest way to obtain this information. Sudden change in structural characteristics has often caused serious damage and many tragic collapses during earthquakes. Therefore one may be interested in the keyword “Abrupt change”. The list of 63 slides related to this keyword is displayed. The list includes small images, short captions and the identification of the earthquake.

Choosing one of the slides, the central page of the information system appears (Fig. 2) In addition to the basic information about the slide, it provides links to more detailed comments on: a) the building and its behaviour (global comment No. 56), b) (three) main causes of failure (failure comments No. 6, 21, and 22), c) as well as the links to related slides. These comments provide more detailed information about the cause of failure as well as the background information about the building and its behaviour.

Choosing the related slide (to detail) No. 236 in Figure 2, the detail of the structure can be examined. From here the user can take even closer look of the detail on slide No. 242 (Figure 3). Slide No. 242 identifies another cause of failure. There are obviously no stirrups to confine the critical bottom part of the column. A novice user may become interested in this new topic even if he/she was not aware of this problem at the beginning of browsing. In this way the system proves to be rather a teaching tool than a data base alone. To get more information, the user may choose the failure comment No. 22 "Stirrups/Hoops" (Figure 4). In addition to the purely technical information, this comment includes additional background information to illustrate the problem and to attract the user's attention (note the style in the first paragraph of the comment).

Figure 2 Central page of the system, providing information about a particular slide

If the user is interested in the topic, related slides with similar information are provided and browsing is continued.

Figure 3 Detail of the structure on the Figure 2

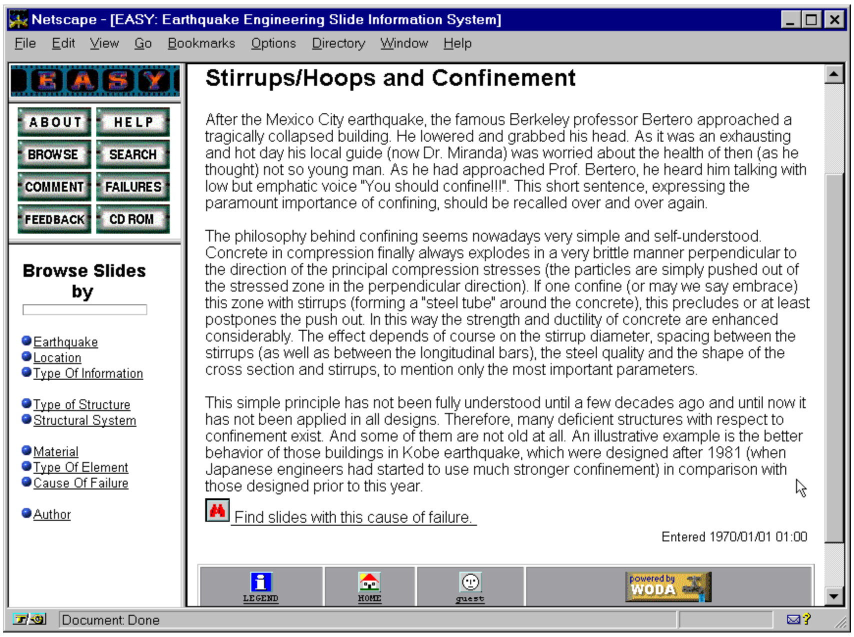

Figure 4 Failure comment with "Find related slides" option

EASY has been used in the Earthquake Engineering course and Disaster Prevention course of the Faculty of Civil Engineering at the University of Ljubljana, as well as on several foreign universities. In the last 3 years the system pages has been accessed on the Web about 50000 times and 1000 CD-ROMS were distributed. A decisive improvement in students' ability to identify the cause of earthquake related failure has been observed.

6. CASE STUDY C: ACCELERATED DEVELOPMENT OF WEB BASED TEACHING AND LEARNING ENVIRONMENTS (Turk 01)

The potential users of the Intranet include professors, students and external users (speaking native or foreign language).

The requested features of the infrastructure, which provides services for these users, include:

- Web based solution. People are used to the Web interface therefore there will be little additional training required.
- Ease of use for information providers. Separation between the authoring of content, conversion into HTML and publishing on the Web is required. There should be no need for the authors of information to be experts in HTML (hypertext mark-up language) or in Web publishing.
- Ease of use for the information users. This can be achieved by providing a uniform and friendly user interface.
- Uniform organisation of information. For example, information about every course a faculty provides, about every professor employed, etc., should follow the same structure.
- Unified look and feel. The design of the Web pages should follow the overall graphical design of a faculty or university.
- Flexibility and openness. The solution should be open for various file formats, import and export of the data etc.
- Moderate price. The development and maintenance should be inexpensive. the required hardware and network infrastructure modest.

The problem is that designing individual Web pages is tedious, slow, and difficult to keep consistent and to maintain by people not fluent in HTML.

Solution

Published information usually follows the same form that makes many Web publishing efforts in fact a database application. Therefore, a good solution to provide information on the Web are databases that should be "Web oriented".

Since 1995 we have been developing a "*web oriented database system*" called WODA (Turk 98). WODA is a CGI application written in Perl language.

Its design goal was to create a smart and simple tool, which would allow very rapid creation of small to medium size database applications that could be used and managed using Web tools. WODA is tightly integrated with Web technology, supports multimedia contents (such as full text articles) file uploads, full-text searches and includes software agent technology. WODA can talk to the user in English, German, French, Spanish, Russian and Slovene. Using WODA, we have learned that web orientation and rapid prototyping tools can outweight database features of commercial systems. WODA dynamically generates all Web pages based on the information schema, responds to end user queries, and allows setting up agents that remind users on the changes in the database.

Implementation

The Intranet of the Faculty of Civil and Geodetic Engineering of the University of Ljubljana (http://fgg.uni-lj.si/) can be examined for demonstration. Only 2000 lines of code, which is partly generated by 4GL tools, define the entire system. This is very little code to write in the first place and to maintain later. Besides these 2000 lines, the Intranet includes a dozen HTML documents. Investment in both money and work has been minimised. The system enables anyone to publish and to maintain the information himself. This has proved to be both a feature and the only major flaw of the system - not all of our colleagues have entered all the information they could into the system. However, without such a system, they would not be present on the Web at all and would not even think of writing Web pages. Among several other applications, WODA also supports EASY – Earthquake Information System, which is explained in the case study B.

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EXPERIENCE WITH ON-LINE GEOTECHNICS TEACHING AT C.T.U. IN PRAGUE, FACULTY OF CIVIL ENGINEERING

Jan Pruška[1]

ABSTRACT: *The impulse to establish a dynamic Web Site was the need of a tool for computer learning in geotechnical engineering at the Department of Geotechnics of the Czech Technical University (CTU). The dynamic Web Site provides an environment in which learning can be easy using the latest developments in learning technology such as multimedia, computer animation, computer-aided learning etc. The dynamic Web Site provides on – line training and information through seminars and check up service in following main topics: geology, soil mechanics, rock mechanics, foundation engineering and tunnelling. We start now to transform our dynamic Web Site to the commercial product WebCT for occasion on-line courses unification at CTU in Prague.*

1. INTRODUCTION

The impulse to establish a on-line geotechnics teaching at the Department of Geotechnics of the Czech Technical University in Prague (CTU) was the need to solve some of the problems of traditional lecture classes. During the academic year 1999-2000, the staff of the department developed and taught courses with a significant on-line supplement to the classroom in following main topics: geology, soil mechanics, rock mechanics, foundation engineering and tunnelling. This presentation covers in the first part start up strategies developed by Department of Geotechnics:
1. technology requirements,
2. general development (designers) principles,
3. the stage of development,
4. use of Web Page with built-in learning materials,
5. the self test checking,
6. use of e-mail to get help and for discussion,
7. evaluation of the on-line courses on the survey results basis.

In the second part is described in detail the web course development, with special focus on the good and bad formation and crisis conditions. Finally thestudents responses are presented together with problems, their solving and strategic development based on the WebCT use.

2. START UP STRATEGIES

In the last few years the Internet has grown significantly being supported by development in multi-media, computer animation and computer-aided learning technology. In fact Internet and Intranet have covered practically all fields of human activities. Success in quickly creating on-line courses and dynamic Web Site will become a major strategic advantage for universities in the future. Assuming this idea,

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during the year 1997, the previously mentioned were developed by Department of Geotechnics.

Technology requirements

Dynamic Web Sites are built in our Intranet with tree topology. All files and data are stored in the department server (Fig.1).

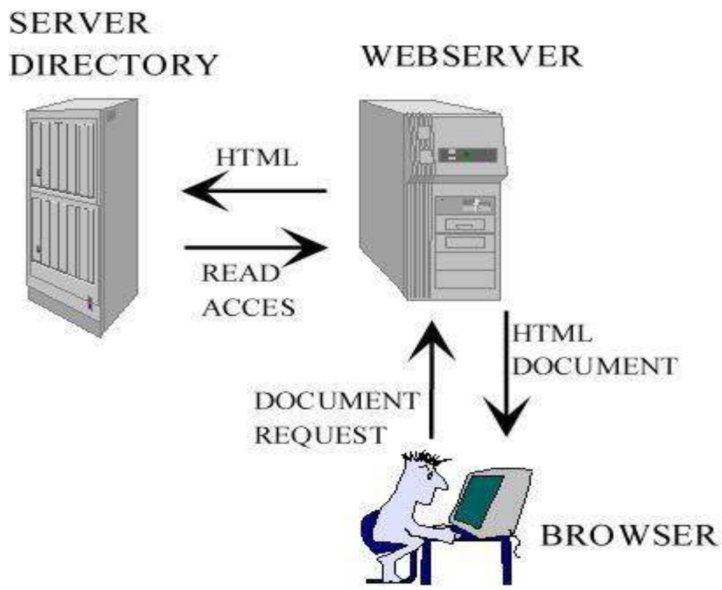

Figure 1 WWW document generation for on-line request

Input data from clients are collected by making use of forms (so called fronted data). Forms contents fields for text input, check boxes etc. By using cgi scripts user dialogues is generated in dynamic HTML. We use Java Script to evaluate user inputs immediately to avoid logical input errors. The authoring part collects account password, ciphers it and sends it to cgi based FTP client at server for identification of given data and then connects to its FTP server to get updated information.

On the server side we use ASP (Active Server Pages) with VBSE (Visual Basic Scripting Editor). On the client side we use HTML 4.0 with Cascade Style Sheets and also Java Script (for evaluate user inputs). We recommended as browser Netscape 4 or MSIE 4. and higher version, for other browser is minimal requirement supporting frames.

On Dynamic Web Sites we support following formats:

- MIME Multipurpose Internet Mail Exchange (binary files where UU encoding is converted to text formats)
- PDF Adobe portable Document Format
- ASCII text
- MS Word text

- HTML text (Hyper Text Mark up Language)
- RTF Rich Text Format
- JPEG with progressive enconding
- GIF Compuserve.

General development principles

We have developed our own on-line geotechnics teaching using following design principles:
– navigation scheme should be simple and identical for each sheet,
– style sheets have not to consist only of the information of the style specification,
– each page size should consist of three screens at most,
– keep the interface simple,
– link the site to their course syllabus,
– older clients should understand our code as easy as possible,
– every document contains a standard set of information (author, e-mail address, date of the last modification etc.),
– related information should be in a good cross-reference (one mouse click, only),
– incremental use from simple to more complex,
– staff members may edit Web Sites themselves without detailed HTML knowledge,
– access files in the current format (i.g. *.pdf, *.rtf etc.)
– every update of Web Sites is recorded by system automatically.

Stage of the development

In the beginning we have used current design of CTU Web Sites (Fig. 2). However, to implement modifications of existing Web Sites and to enhance more levels and cross-references was rather complicated and time spending procedure.

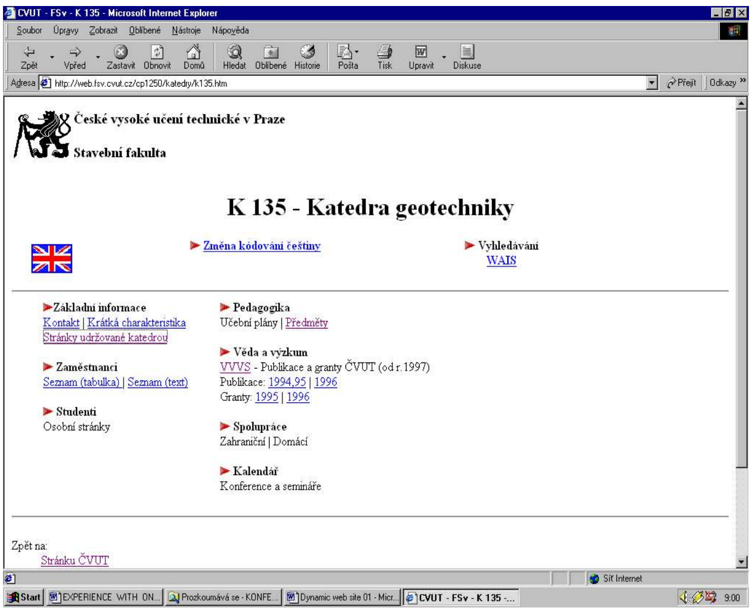

Figure 2 Current design of CTU Web Site

During the academic year 1998/1999 we have developed our own web courses, but without check up service. In the next year the staff of the department developed and taught web courses based on the dynamic Web Sites with a significant on-line checking.

Student´s performance can be automatically assessed and recorded. This dynamic Web Sites (Fig. 3) provide seminars (check up services are labeled by asterisk) in the following courses:

- geology,
- soil mechanics,
- rock mechanics,
- foundation engineering,
- tunnelling.

We start now the last development stage. All on-line courses at CTU in Prague are now united on WebCT product.

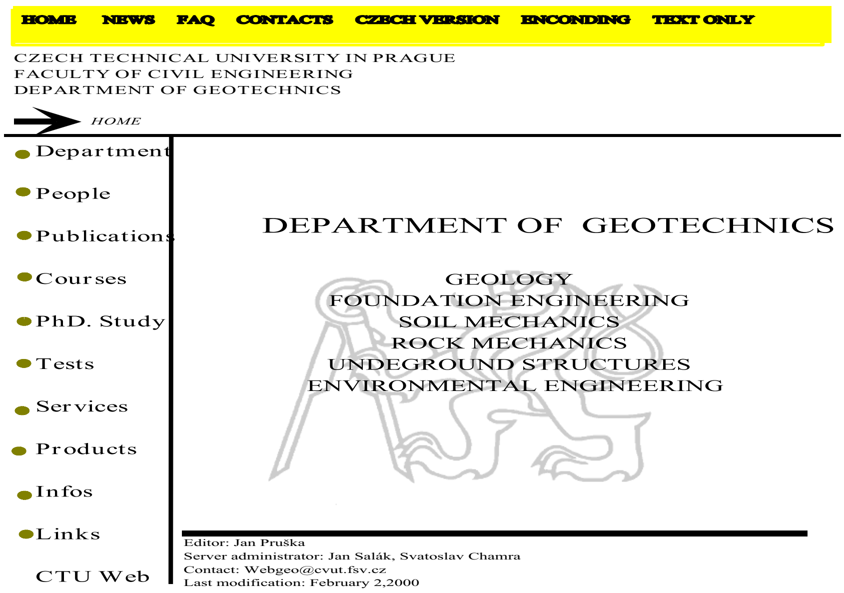

Figure 3 Home page of Dynamic Web Sites

Use of Web Page with built-in learning materials

There are numerous benefits of taking Geotechnics courses on – line:

- you have communication with the other students and professors (not only during class and office hours)
- you can take an on-line course from computer in any location
- you can do course work at any time you want
- you can rewiev the lecture notes
- you have enough training, just in time
- your excercises are on – line checked

3. WEB COURSE DEVELOPMENT

For a ideal on-line course development we recommend to consider the following topics:

- clear definition of project goals, course objectives, student activities, test volume, evaluation criteria
- time for planned development is over a period of month
- do not say "This part of my course will be on the web this week"
- develop the course sites that are easy to maintain and support
- make sites relatively easy for "new" users
- use a rich resources (video files, authority mentors etc.)
- provide the instructions for editing and updating course pages and templates
- develop the FAQ page
- manage more than one version of the file on the course
- if possible, use the path editor
- users want to use a sophisticated tools such as search, glossary, index
- provide on-line versions of the workshops, but use rather short, single topic
- use e-mail listserv to help users stay up to date on the latest support, training, development and technology news

4. STUDENT RESPONSES, PROBLEMS

Since 1998 Department of geotechnics offered geotechnics courses on the web (the fall 1998 courses were developed for soil mechanics only by staying 3 weeks ahead of the students) as supplements to the traditional lecture. The student responses on the on-line courses were collected by questionnaires.

The survey was taken voluntarily. From the survey evaluation emerged following students' remarks:

- on-line check-up tests are extra work
- interaction with teachers via e-mail is limited
- all exams have to be downloading
- every topics would have repetition material
- set deadlines for the completion of assignments
- give the exams solution at set time.

Two types of problems were obtained during the course. Multiple choice problems were provided that gave the student immediate feedback. Other problems were assigned for the students to present in groups. Each student was expected to work every team problem, however many of them did not do this.

5. USING WEB CT

We start now to transform our dynamic Web Site to the commercial product WebCT for ocassional on-line courses unification at CTU in Prague. On the www address http://www.ctt.bc.ca/landonline/choices.html we found independent comparison of 42 professional tools for developing Web courses.

Many products have very similar parameters, so it is very difficult to take out the best product. Furthermore the progress on this field is very rapid. The reasons for choosing WebCT at CTU in Prague were primarily as follows:

- WebCT provides interface for creating courses presentation,
- WebCT offers a collection of learning tools for teaching, communication and cooperation,
- WebCT has administrative tools which facilitates courses management and improving.

WebCT software can be used to create entire on-line courses or to make a complement of classroom based course. WebCT software resides on a server, allowing you and your students to access it via a web browser, such as Netscape or Microsoft Internet Explorer. It also allows you to make changes in your course readily (from any web accessible location) and to make these changes available to your students immediately. You can use WebCT to:

- provide courses materials that include texts, images, video and audio,
- produce learning aids such as searchable indexes, glossaries and image databases,
- integrate web resources into your courses,
- obtain data that allows you to analyse the effectivnes of your course,
- create opportunities for students to be knowledge builders,
- to encourage students to interact by using hyperlinks to websites and real time chat session,
- communicate with students via email, on-line discussion and an interactive board,
- evaluate students with tests and assignments,
- manage grades,
- supply feedback to students via on-line grade book, self tests and progress tracking.

WebCT offers four key products and services:

1. WebCT software – can be used to create entire courses on-line or to make a complement of classroom based curse.
2. e-Learning Hub – hosts e-learning communities in a variety of academic disciplines, each community provides expertise and resources to instructors and students.
3. e-Learning Resource Packs – are created by leading publishers in the education field and contains a set of customizable on-line course materials developed and formatted for use in WebCT. Alternatively you can use e-Learning Resource packs as a stand alone unit which provides a component of your on-line course.
4. WebCT Newsletters – are electronic newsletters featuring information of interest to web based teachers and users.

Together, these resources can be used to create an affective web educational environment.

6. CONCLUSIONS

- On – line support is necessary and appreciated
- Interactivity is the key to success
- Interactivity can and should be planned
- Teamwork should include individual responsibilities and grades
- Majors will respond well to a rigorous on – line courses

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PART THREE

Postgraduate Programmes and Continuous Professional Development in Civil Engineering

ENHANCING THE ROLE OF THE UNIVERSITIES IN CONTINUING (CIVIL) ENGINEERING EDUCATION: A CHALLENGE AT THE BEGINNING OF THE 21ST CENTURY

Amaury Legait[1] & Roger Frank[2]

***ABSTRACT**: Life long learning in civil engineering is becoming a commercial activity. In this article, we present our views on the future evolution of the market. Starting from today's market, we forecast the demand for new courseware and new pedagogical methods. We introduce criteria applicable to strategic analysis for universities and possible strategies. The role of the universities will not be enhanced by a generic common commercial strategy. But each university should have its own one.*

1. INTRODUCTION

Our article mainly looks at the market driven aspects of the challenge. We use a business oriented vocabulary: customers, competitors, products. Let us be clear: should we like it or not, life-long learning in civil engineering is becoming a commercial issue and universities have to adapt to this new commercial competition. Universities have to enhance their pedagogical offer with the goal to answer the demand of the customers. Competition exists for continuing education and as the gap between initial and continuing education in civil engineering does disappear, worldwide competition between universities is becoming commercial altogether.

2. THE MARKET APPROACH

Market analysis (Rapport, 2000) is available. In this section we rather would like to give our understanding of the evolution of the market place.

Our customers

In the past, our customers were looking for additional expertise and qualification on technical issues. They were, and are, the technical staff of the French Ministry of Equipment, managers of the local authorities, and engineers working for private companies of the civil engineering sector.

Our customers have not changed in persons, but in demand. Today, they are asking for management and techniques (not techniques only). Their purchasing department is asking for always lower prices. As the activity in the construction sector is good (beginning of 2001), part-time and distance teaching is seen as a solution to combine a high level of activity and a real need for training and continuing education.

Management is also asking for e-learning, because it is fashionable.

Life long learning is a real request from the learners, but not yet from the companies themselves. In France, a new law is to be voted and we are waiting for its

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application with some impatience. This new law, called "*Law on social modernisation*", includes three articles on life long learning (articles 40, 41 and 42). At present, companies are obliged to invest in continuing education a fixed percentage of their total wages bill. The new law replaces this obligation by a commitment to obtain a given number of diplomas. Furthermore, the new diplomas will be allowed to take into account professional experience, as much as classical education courses. And, as a consequence, the demand for such 'professional' diplomas is expected to increase greatly.

Our competitors

They were specialised on given technical topics ("niche" market). They tend to develop their management offer.

Today, they are more aggressive. The net margin on tailor-made operations is low, as the purchasing departments of our customers are asking for lower prices to everybody.

Private education companies tend to focus on the marketing effort rather than on the pedagogical content and quality.

A substantial part of our competitors have ISO 9000 (2000) certification, at least for the registration of students and billing processes.

Our products

Our off-the-shelf products were technical, typically one week-long. They tend to be shorter (one, two or three days).

We have more tailor-made products (pedagogical curriculum) for internal use in the companies, including management.

We are working on CD-Rom based products (Eurocodes) and we are moving slowly into e-learning.

3. THE NEW COURSEWARE CONTENTS IN CIVIL ENGINEERING

Young engineers coming out of the standard education system have a good knowledge of technologies and of project management including financing. In the past, education has evolved, like construction contracts, from build to DBFO (design, build, fund and operate).

In the future, we foresee a stable demand for knowledge maintenance and an increasing demand for training in new technologies and new services.

Using coursewares[3], new pedagogical products will have to be designed by composing them.

New technologies

We already have a strong request for presentation of Eurocodes (design) or Euronorms altogether (products, execution, services). European standards and regulations in the construction sector will be a long lasting product for life long learning.

We foresee a demand for management practices in the use and protection of patented technologies (instead of free technologies).

[3] Courseware : a pedagogical component like slides, an exercise, a chapter of a book or a case study

Intelligent home and integration of the new information and communication technologies will also request training, but in a limited number of topics.

New Services

Topics like audit and quality, security, social sciences, social law are already on our product list. Due to the overwhelming application of the principle of prudence and of the principle of precaution, the demand should increase.

For an increasing number of companies, it seems clear that more business will develop in services and maintenance than in new constructions. Engineers and managers will have to be trained to new processes for operation and maintenance. Rehabilitation and deconstruction will become an important activity for which new practices will have to be taught.

At the very heart of the culture of civil engineering, we find today integration of buildings design and urban design. Though they have been taught for a long time now, environmental issues are really becoming critical. It is not clear to us how life long education of traditional engineers is efficiently encompassing this new demand. Is it possible to provide life long education for a new culture?

4. THE NEW PEDAGOGICAL METHODS IN ENGINEERING

Today, books and pedagogical supports include CD-Roms with links to Websites where the latest up-dates of reference documents are available. Young engineers have an existing culture in the use of the so-called 'new information and communication technologies.

On Internet, technical and scientific contents are available for almost nothing on almost everything. Pedagogical standards (SCORM) and products are becoming available. But, for the educational institutions, the price for initial marketing is very high.

Recent studies (Ovarep, 2001) indicate that companies are evolving slowly toward the use of new technologies in education. Cost reduction seems to be the incentive but efficiency is not yet proven.

Distance learning is evolving toward a mixed model including some introductory work in a classical classroom, work on pedagogical courseware available on the Internet, sharing of knowledge among the students by mail and regulation by forum discussion. Success at the final exams remains the condition to receive the diploma.

5. CRITERIA FOR A STRATEGIC ANALYSIS

The Eucen project has developed a manager's handbook with emphasis on some tools for strategic analysis (Eucen). Here, we use two well-known strategic analysis techniques: SWOT (strengths, weaknesses, opportunities and threats) and competency analysis. The social and moral debate should not be forgotten and should be part of the strategic decision.

6. SWOT

Strengths and weaknesses: They are the criteria internal to universities.

Existing approach	Newly suggested approach
Few full time professors	Part time contributors from industry and research
Internal services for all support activities	Subcontracting of all support activities
Home made lectures	System engineering used to design courses from courseware and experience
Internal expertise	Distributed knowledge available free of charge on the Internet

Opportunities and threats: They are the criteria external to universities.

Existing approach	Newly suggested approach
Internal home made courseware	Courseware available in libraries and Internet
Home made curriculum	ECTS[4] based diplomas
Academic knowledge	Best practices from industry
Diploma only available from state managed institutions	Diploma available as commercial product
Academic curriculum	Integration of professional experience and academic courses
Home made examaminations	Examinations organised by non-educational institutions (certification institutions).
Internal evaluations of tuition	Independent evaluations of tuition available on the Internet : price, quality of education, salary of alumni, food, etc.

Competency analysis

Inside a university, the pure knowledge will be less important. The university will expect from its professors more expertise in integration of existing courseware and in design of pedagogical products.

As the professors will teach less and will spend more time in advising and coaching, the emphasis will be put on communication skills and pedagogical skills.

For life long learning, professional experience of the professors will be mandatory.

Social and moral debate

Some professors and some universities have a clear tradition of education as a non-profit making activity. For most people, the standard model is a state-owned and state-financed education system. Knowledge and pedagogical services were free. Some time, continuing education was a paying service, when provided to companies. For centuries the knowledge was stored in books. Interaction took place with the professors. The model was stable.

During the past twenty years, knowledge was stored in the Internet. Some pedagogical models thus give more emphasis on interaction among the students than with the professors.

[4] ECTS : European Credit Transfer System. One ECTS credit is approximately a ten hour course

A new economical model is also under discussion: free knowledge but paying pedagogical services. Thus education would nearly always become a product to buy. Continuing education is acknowledged as a paying service.
When initial education is close to continuing education (master of science, mastère spécialisé), it tends to become a paying product.

7. STRATEGIES FOR UNIVERSITIES

One should note that the council for advancement and support of education (CASE) is providing advice and training in strategic analysis for educational institution.

In innovation management, one finds always three strategies. Early adopters (now), main-stream followers (within ten years) and late comers (at the end of the 21st century or never).

With regard to the commercial approach and to the use of new educational technologies, the picture we have today is the following:

- Early adopters: individuals in Europe, universities in Australia and of course the USA
- Main-stream followers: Europe, South America
- Late comers: Japan, Africa, Middle East

Of course, "red brick" universities are more reactive than "old stones". But Oxbridge, Collège de France or MIT are eager to use new technologies and pedagogical innovation.

For some people, the new economical model is a social threat to the initial education; for some, it is a commercial opportunity.

We do not suggest any choice. We believe that people have to make their own decision.

8. CONCLUSION

The world of education is changing, faster than earlier. But Cato the Ancient, Cicero and Tite-Live already agreed with this statement, though strategic analysis was not yet available.

Slowly, education in civil engineering is becoming a commercial product. The European culture has traditionally identified knowledge as a free product. The American approach is promoting pedagogy as a commercial product. The World Trade Organisation (WTO, 2001) has started negotiations on the educational services.

Education is still a long lasting product with no cycles. Education institutions have to evolve at the right pace. Universities should have a commercial strategy and they should start to use strategic analysis.

Life long learning in civil engineering is more exciting than ever!

ACKNOWLEDGMENTS

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7. SCORM: www.adlnet.com

THE PROFESSIONAL ASSOCIATIONS AND THE CONTINUOUS PROFESSIONAL DEVELOPMENT OF CIVIL ENGINEERS

Vassili Economopoulos[1]

***ABSTRACT**: The substantial impact in the education, training and employment caused by recent developments of the information society and relevant technologies, together with economical globalisation, requires a substantial reorientation in connection with the continuing education and continuous professional development of civil engineers. These are crucial factors for their career planning, competence and professional flexibility. Although from the year 2000 the number of people undergoing any form of CPD in EU countries exceeds the total number of those involved in the whole initial education system, there are some critical matters in Europe CPD policy that are being subjected to analysis and certain proposals/directions are presented, emphasizing the broad perspective opened for a fruitful national and international cooperation between educational systems and professional associations in the field of civil engineering.*

1. INTRODUCTION

On the beginning, let us try to give a definition of the Civil Engineer: An Engineer is considered to be a person possessing the skills and the knowledge to combine analytical and synthetic approaches for detecting problems in order to find and to apply reliable, safe, economical, socially and environmental acceptable solutions.

From this point of view the engineer is a producer, a decision-maker, as well as a leader. The civil engineering works are constructed to serve man and from this the humanistic dimension of our profession is emerged. However, which is the current environment within the Civil Engineer develops his career as a student and then as a professional? The great questions set by the current conditions are:

- The information society and the relevant technologies have caused substantial impacts in the education, training and employment. The evolutions in telecommunications, teleworking, e-learning, e-commerce via Internet are running rapidly. Today in USA the users of Internet are amounted to a 40% of the population, in Europe this percentage varies from 8% to 20% and in Greece today this percentage is defined to 4,5%. Mr. Likaanen the responsible EU Commissioner underlined the following: In USA the information society has created 2,3 million new employment positions in 1999 (1,6 million new employment positions in 1998). On the other hand the Internet economy market in USA develops on 500 billion USD in 1999 (300 billion USD in 1998). In Europe a similar big expansion is expected. In 2000 the Internet market is expected to increase for 40% in Europe. In many European Countries the market of mobile telecommunication is increased with a pace of 1% per month, thus arising this European Industry as the leader of the world market. The European telecommunication market increased for 6,5% in comparison with 1998 (up to 160 billion Euro in 1999).

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[1] Technical Chamber of Greece, ECCE Vice-President

- The globalization of the economy is led directly to an intensive free circulation of capitals, goods, services and persons. So, the employment market is changed rapidly.
- The tremendous expansion and development of the scientific and technical subjects.
- The shortage of available resources of energy and raw materials.
- The environmental problems and the consequent strategy for the sustainable development. According to the concept of Sustainable Development, the traditional principles upon which development has been based so far, and the basic priorities of our technological model of civilization as well, seem to need reorientation.

2. NEW TRENDS IN EDUCATIONAL AND TRAINING PROCESS IN CIVIL ENGINEERING

The attempts to find some answers in the CE education, training and the formation of his career, are led to:
- Give focus on general education and responsibility. The report of European Round Table of Industrialists underlined the necessity of a multitask training based on enlarge knowledges which will develop the autonomy of thinking and acting. The report also emphasize the life long learning for integrated personalities, acquisition of skills for the general education, the cultural enlargement and the awareness of the social responsibility. The new above needs and changes in the market, in the production and in the society must be surely met by new trends in the education and training process. We already speak for the interdisciplinary and for the inclusion of new fields like environment, project management, financial management, rehabilitation and maintenance, health and safety, special law matters, public procurement management.

The new trends in educational and training process include:

- Emphasis on the integrated design-capstone design courses
- Use of case studies in teaching
- IT in teaching and learning
- Improvement of the communication skills of the students
- Practical training

In Greece, after the Second World War the Civil Engineers graduates from the National Technical University of Athens were the leaders of the reconstruction of all the country. The structure of the studies in NTUA has five years ("continental" educational system for engineers) of high level education with a strong theoretical background. The basic points of the recent reformation of the educational programme were:

- Upgrading the IT educational programmes and the relevant applications for CE
- Enrichment of the Environment educational programmes
- Enrichment of the New Technologies and Materials educational programmes
- Project management of special significance construction works
- Emphasis on maintenance, rehabilitation and safety
- Upgrading of the educational role of the laboratories
- More effective structure of the timetables. Total teaching hrs 230 hrs. For every six months there are 7-8 lessons and weekly timetable up to 25 hrs on average
- Strengthen the active participation of the students in the educational process
- Attract the interest of the students already from the firstly two years with early incorporation of technological lessons.

- New skills adapted on the new conditions of the market. We have already mentioned above some of the new emerging professional fields for the CE profession. Organisation of efficient career planning systems and flexible models of professional reorientation are needed. The Continuing Education and Continuing Professional Development are the crucial factors for effective career planning, reorientation and competence.

3. NECESSITY AND IMPORTANCE OF CONTINUOUS PROFESSIONAL DEVELOPMENT (CPD)

We define CPD as: the planned acquisition of knowledge, experience and skills and the development of personal qualities necessary for the execution of professional and technical duties throughout an engineer's professional life. It encompasses both technical and not technical matters.

According the results of relevant surveys (IRDAC and other sources), while a 10% increase in capital expenditure per employee would boost productivity by 3%, a 10% increase in labour quality would boost productivity by 7%. The 40% of competitive improvement in industry stems from expenditure on resources (machines, buildings, educated Employees), while the other 60% emanates from the way the above resources are used. The best use of such resources is obtained through CPD.

The principle necessity for CPD arises from the obsolescence of knowledge acquired in the Universities. Based on the concept of the half-time of knowledge, there are evaluations for this half-time with estimation approximately from three and a half to four years. The education of Civil Engineers offered in the Technical Universities is often not adapted to preparing the graduate to face the problems encountered in practice. In the frame of the logic of a researcher (developed during post graduated studies) or ready-made solutions are insufficient to solve a practical problem. There is a difference between the quality profile of the University Engineer at graduation and the corresponding requirement profile.

The CPD situation in European Union is clearly described by the figures given by the Industrial Research and Development Advisory Committee of the EU Commission (IRDAC). From these we can extract the following:

- From this year 2000 the number of people undergoing any form of CPD in EU will exceed the number of pupils and students in the whole initial education system (from primary to higher education).
- Comparative data from EU Member States

#UK 1987 data indicated CPD for 48% of employees

#Germany 37% of all population aged 19-64 received CPD in 1991

#France In 1990, 30% of the active population got any form of CPD, which is twice the figure of 15 years ago

#Italy The data available suggests that at least 10% of the working population receives some form of CPD

- It is estimated that the overall annual financial expenditure on CPD in the EU to be approximately 40 billion Ecu.
- The about 3000 higher education institutions in the EU play only a very small part in the supply of CPD. The direct higher education involvement in the CPD processes is at most 10%.

- The results of the relevant reports of the IRDAC and ERT agree that “given the pace of technological change a massive investment in upgrading the human potential with continuing education and training will be needed”.

4. CRITICAL MATTERS IN EUROPEAN CPD POLICY

There are some critical matters in Europe CPD policy:

- There is a lack of proper planning and of accurate information of CPD data (where the training takes place and by whom it is delivered, the nature of training, the type of subject).
- There is no clear picture about the funding CPD. Funding is sourced from the EU, national governments, employers and the individual.
- There is a large number and diverse quality of training and training providers. There is a little quality control and few standards and norms that would allow evaluation.
- There is a growing interest for the implementation of some kind of evaluation, certification, accreditation and quality control for the courses and training programmes.
- Particular needs of SME’s need to develop their competence on a par larger companies, but their CPD record is weak.
- Responsibility for funding CPD provision and responsibility for providing the infrastructure.
- Clarification of the roles in the CPD market.

Public Authorities

- value for money
- return on investment of public funds
- how CPD provision is regulated

Employers

- value for money
- return on investment
- how CPD is regulated
- what is the role of the professional engineering associations in the issue of credibility

CPD Providers

- accreditation of providers
- quality assessment and certification of provided services
- defining and recording individual skills and competencies for particular functions
- strategic role for engineering professional associations

5. PROPOSAL FOR IMPROVEMENT OF CPD

Therefore, the propositions/directions for CE from the above data will be:

- Requirement of evidence and data for a CPD register (individual CPD record, and register for accredited employers)
- The significant role of engineering professional associations as CPD providers, regulatory bodies and an installed framework to strongly motivate their members
- Effective career planning for Civil Engineers
- Accreditation of CPD providers
- Improved communication between all partners regarding CPD

- Strong cooperation between Technical Universities and enterprises
- Low cost and proper training CPD programmes for SME's
- Distance learning and self training packages for the individual effective CPD and on the job training.

I think that in this field of CPD development there is a broad perspective for fruitful cooperation between Technical Chamber of Greece and other Professional Associations of Engineers in Europe.

6. CONCLUSIONS

Of course, this presentation is targeted on Education and Training formation of Civil Engineers. In ECCE, we have completed a comparative study "The Civil Engineering Profession in Europe" with surveying of 16 parameters (education system, recognition and protection of professional titles, training, numbers of qualified engineers, professional organisations and registration, legal background to the profession, contacts, services offered, fee scales, insurance and professional liabilities, social security, civil engineering in practice, the civil engineer's office, publications, CPD).

In Greece as in the European South also, the CE profession is structured in individual professionals and in small and medium consulting and contracting companies and the action of the CE profession is protected by the law. At this time the great perspectives of Greek Civil Engineers are focused on the completion of the big infrastructure works also the related construction works for the Olympic Games 2004 in Athens.

In the closing of this presentation, it is interesting how the young and candidate professionals-Civil Engineers look at themselves. From a relative study, among the main findings are the following:

- the most important factors in choosing the profession were the interest in "positive" sciences, good results obtained in high school and the ambition "to create something new"
- the satisfaction gained from the importance paid to working conditions were mainly dependent on the diversity of duties, the4 responsibilities assumed and the "ambience" of working place and less on the opportunities of salary
- finally, the most important elements in determining professional success have been defined as the satisfaction even passion for the job, the (personal) performance and evolution and creativity.

In this very competitive century, the Civil Engineers in all around the world we have to maintain this strong passion of our work and to assure the high quality of our work!

OPEN AND DISTANCE EDUCATION FOR THE ROMANIAN INFRASTRUCTURE

Iordan Petrescu [1]

ABSTRACT*: A major competitive parameter in a knowledge society is engineers' and technicians' competence, especially in the industry subject to very fast innovation processes. Continuing Professional Development of engineers and technicians is therefore very important. A model for the continuing education process is described. The basic elements and their interaction is also presented and discussed. It is important to achieve a joint understanding of what professional development is and to acknowledge that it is not the University education any longer. Part of the modelling is based on Romanian experience in development and implementing a Distance Learning Methodology in training a large number of road and bridge technicians.*

1. INTRODUCTION

Knowledge and competence have become two of the most competitive parameters in the Information Technology (IT) consumer product industry in recent years. In order to maintain a competitive advantage, engineers must always be one step ahead in incorporating the new knowledge into their products. For this reason, Continuing Professional Development (CPD) of engineers has become increasingly vital. CPD includes the development of professional theoretical skills in addition to the practical works functions – i.e. a combination of continuing engineering education along with productive engineering.

Planning the professional development educational activities must be highly dynamic in order to accommodate the rapid innovation processes found in the organizational environments and therefore cannot be rigidly scheduled. Further, the framework for the professional development courses must include fast, continuous follow –ups on the needs identified by the organization to ensure that the engineers are continuously obtaining the never – static skills and knowledge necessary to get their goals. Exchange of the information between the university and the company is thus critical in the establishment of an effective framework for professional development.

2. CONTINUING PROFESSIONAL DEVELOPMENT AS A UNIVERSITY ACTIVITY

Because the field of continuing education is still relatively new to universities, programs may not yet be integrated into the university's educational and administrative practices. It is important to consider why the university teachers should be involved in this activity, what will be the goals to achieve and how it must be implemented. It is quite possible that the university wishing to integrate continuing education programs into their systems will encounter perceptual barriers – e.g. that there is less prestige

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associated with continuing education courses than with research related activities and thus less interest.

The dynamic nature of the continuing education may also present a barrier in adopting these programs because the university culture is usually based on rigid planning and clear administrative practices that are not applicable in this case. The university must be prepared to offer these courses on demand, rather than according to a rigid and pre – determined schedule. Further, flexibility in terms of class size, content and scheduling will make it necessary to allocate additional resources in order to prevent overburdening existing lectures.

Basically there are two types of teaching and learning methods from which the company may select: company – oriented or university – oriented methods. Company – oriented methods may then vary according to structure, such as:

- The project form, which may be characterized as a co-operative agreement between the university and the company to participate in the development and to incorporate work based learning
- Just in time courses or courses on demand in which the company defines its actual needs for knowledge development and the university quickly plans special courses to satisfy these needs.

To a great extent, the university-oriented methods can be thought of in terms of ready-made courses within given subjects, offered to both individual company and groups of companies.

3. CONTINUING PROFESSIONAL DEVELOPMENT AS A COMPANY TASK

The industrial organization must realize the necessity of having access to the research based knowledge present at the university and which goals they have to achieve.

Consideration must be given to the methods for applying the learned knowledge and skills in the company and thus integration of the newly learned professional skills should serve as one important criterion for success of the development process. Because the needs and value of organizations will certainly vary in nature, it is imperative that individual organization explicitly describes the specific criteria that will be used to evaluate their own professional process.

The goals should be presented as specifically as possible and be part of a mutual agreement between the university and the participating company. The company should take an active part in formulating the goals and the success criteria. Experience from many continuing education courses indicate that it is quite often the absence of such formulation of success criteria that leads to ambiguous and ineffective evaluation of the completed courses.

Internal organization strategies for continuing education play a role in planning of continuing education courses. The company strategies may vary greatly in the following manner:

- Total strategic planning for the company, where a basic education course plan is established for a number of employees
- Individual employee strategies, where employees select their own continuing education courses, which may or may not be the same as the choices of their colleagues.

The strategy that the company selects will greatly influence the formulation of the professional goals, success criteria and the nature of co-operation and interaction between the university and the company during the development process. The most important terms of selecting a particular strategy or combination of strategies is that the professional needs and goals of the company can be met and that the strategy in the best way possible reflects the dynamic industrial environment in which the engineers function.

4. CURRENT CRISIS IN EDUCATION AND TRAINING

It does not take a genius to observe that we all live in fast changing times, where tomorrow's fantasies rapidly become today's realities. Nowhere is this true than in the construction industry, where new building techniques and new materials are the order of the day. It is a volatile market, where clients are always changing their terms of references and where long established hierarchies have been swept aside by computer technology, changing working practices and new management techniques.

In the world today, organizations must be both fit and flexible in order to survive the rapid pace of change. Generally speaking, it is not too difficult for companies to upgrade their material resources – in relative terms the cost of both computer hardware and software has declined. The biggest difficulty comes in upgrading the skills of their workforce – a fit and flexible organization needs a fit and flexible workforce.

The industry is heavily reliant on the educational system to provide a workforce that can survive in today's tough and ever changing working environment. But is education in the position to meet these needs?

We can contrast the position of the industry with that of higher education (Fig. 1).

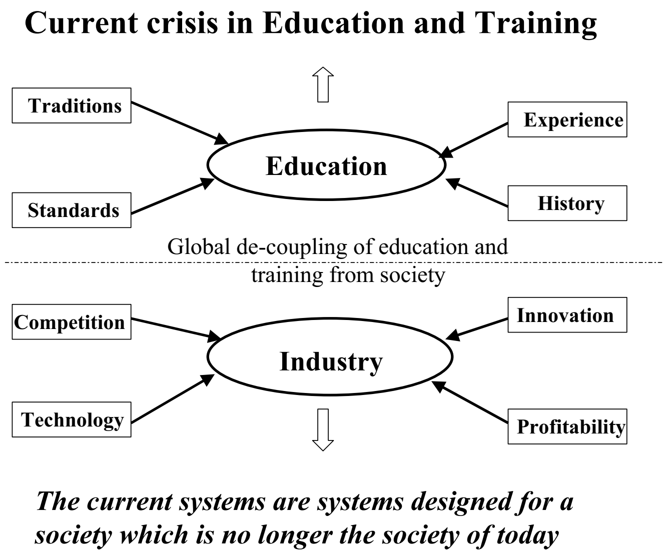

Figure 1

Of course, the divergence of industry and education has major implications. At the point of entry in labor market, the new members of the workforce – the young graduates – must be able to adapt very rapidly to changing circumstances; there is little time for them to slowly find their place, they must enter on their feet and run. So, is higher education providing this type of graduate?
And further down the line – what about those who are already in the workforce – the experienced engineers and technicians, who are often struggling to keep the pace of changing? They need to update knowledge, learn new skills, adapt to new situations and learn how to survive.

This is what we mean when we talk about continuing professional development.

5. PARADIGM SHIFTS

Various types of course forms and technologies, which may be used in both course development and course delivery must be considered, such us:
- Online courses – the teaching form is a net –based education
- Mixed-courses – the teaching form combines face-to-face with net-based education
- Face-to-face courses – traditional teaching forms are used.

Depending on the organisatoral culture, history and management, both the universities and the companies are faced with some paradigms that will influence the decision in adopting the strategy of continuous professional development. Three such paradigms shifts will be presented:
- Paradigm shifts society (fig. 2)
- Paradigm shift learning (fig. 3)
- Paradigm shift delivery (fig. 4)

Paradigm shifts: Society

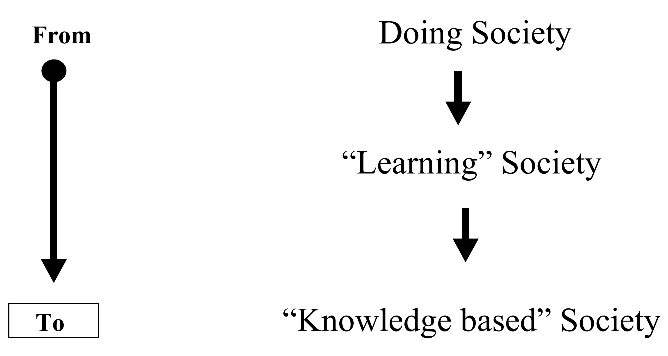

Figure 2

The Values of Knowledge Society
•Competitiveness with social inclusion
•Risk: management over minimization
•Lifelong learning for all

•Social Innovation, not technological invention
•“Small is beautiful”
•Participation over representation
•Interdependence over independence
•Value-added with values

Paradigm shifts: Learning

Lifestyle Patterns Are Changing Rapidly

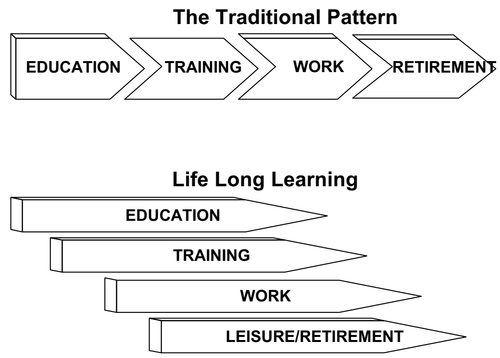

Figure 3

Paradigm shifts: Delivery

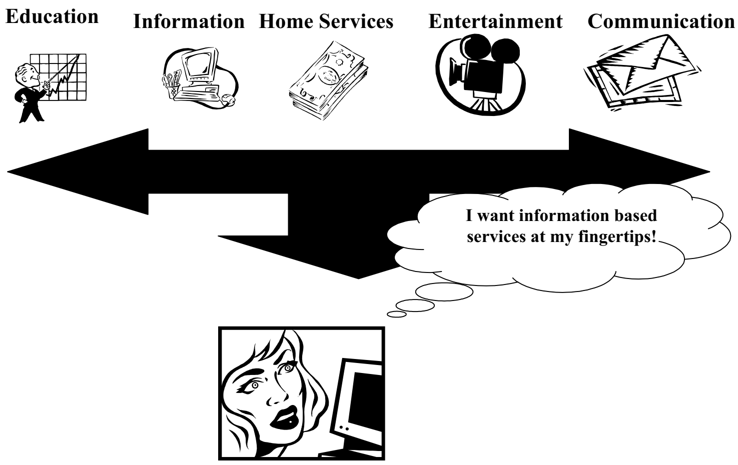

Figure 4

6. GLOBALIZATION AND INFORMATION TECHNOLOGY

European higher education is in a period of transition with several on-going developments in play at the same time Here we will focus on several on them:
•Technology assumes an ever-growing role
•ICT becomes part of daily life = new knowledge & skills
•Reduced demand for low-skilled workers
•Rapid obsolescence of skills
•Increasing need for flexible and customised education & training = new education models
•Lifelong learning available at the learner's convenience
•High content demand
•Free market for adults

To take into account some of the above mentioned characteristics of training we need to re-engineer:
•The educational infrastructure
•The curriculum
•The teaching profession

This implies:
•A Culture of Lifelong Learning
•Access to lifelong learning
•Content to support individual lifelong learners
•A social context for lifelong learning

The new educational models are required to accommodate the increasing need for needs-based and personal lifelong learning that is accessible for everybody and available at the convenience of the learners. Hence, learning and training will occur to a high extent of demand, having the following characteristics:
•**DISTRIBUTED**: self-directed and accessible on demand
•**MODULAR**: education packages addresses to a single skill
•**MULTYSENSORY**: education stimulates sight, hearing and a touch in a variety of ways
•**PORTABLE**: Education is easily moved with the employee
•**INTERRUPTIBLE**: The student can stop and start easily
•**NONLINEAR**: There is no fixed sequence of modules
•**TRANSFERABLE**: Movement is easy across the culture
•**RESPONSIVE**: Development cycle is short.

7. CHALLENGE TO DEVELOP EDUCATIONAL MATERIAL

Fits directly for the purpose of learner (customer-oriented or on demand)
Is timely: available at the moment new skills are needed
Is easily accessible in terms of time, place and pace
Is effective and **affordable**
Takes advantage of the new learning technologies
Is company-specific and embodies in-house expertise: in cases where the learning happens in function of the employment
Is accredited or quality guaranteed.

It should be clear that we are working here within the Open and Distance Learning (ODL) paradigm, which implies that learning situations we are considering are mainly self-study situation with some guidance or tuition, and the times when and the place where learning takes place are not the main characteristics on which we can build a typology.

To characterize the ODL systems by considering the educational situations on which they are based we have to consider the following features (fig. 5):

- The presence or the absence of the trainer, characterizing the human mediation dimension of the system
- The presence or the absence of an electronic network characterizing the technical mediation dimension of the system.

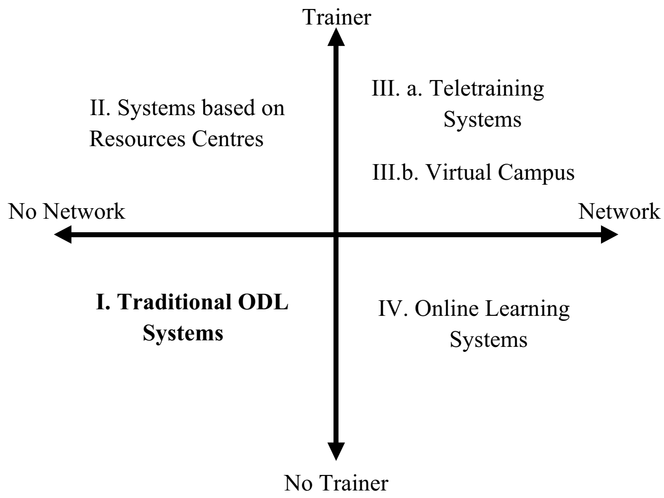

Figure 5

The first quadrant in the fig. 5, namely No trainer – No network, characterizes the traditional Open and Distance Learning systems. Taking into account the Romanian economical and social condition it was decided to design and to implement such a traditional Distance Learning scheme to train a large number of staff who work in the road and bridge field.

8. OPEN AND DISTANCE LEARNING FOR ROMANIAN HIGHWAY INFRASTRUCTURE

In 1991, a partnership was formed between Technical University of Civil Engineering Bucharest (TUCEB) and other organizations in Romania and City of Bath College (CBC), to facilitate the development of a resource based learning to meet the precise and specific needs of Romanian highway construction and maintenance industry. The partnership, with the backing of a EC's Tempus Programme has enabled a unique transference of both informational and pedagogical technology from Western Europe to Romania.

In co-operation with CBC, members of the teaching staff from Technical University of Civil Engineering Bucharest have produced the first resource based learning programme for the Romanian highway industry. The main objective was to train through Distance Learning a large number of staff who work in the road and bridge field to acquire the most up to date know-how.

The National Roads Administration (NAR) was well aware that TUCEB and CBC have been working together in the Tempus Joint European Project EUROHOT and completed the development in Romania of a Distance Learning Scheme, particularly suitable for continuing training of staff working in different worksites, as in the case of highway projects.

The distance learning methodology is applicable particularly to projects which imply a widespread of workforce in the field, a characteristic of highway construction and maintenance activities. The fundamentals of method consist in the fact that it uses modularized manuals adapted to user requirements. Other resources were added to the handbooks in order to increase their efficiency, such as videocassettes, depending on the possibilities of the consultant.

The individual student is connected to a local network of tutors, which provide guidance according with the employer's requirements National Roads Administration.

The main benefits to the employer are: the study documentation is oriented towards the needs of the workplace and the professional level of the student; involvement of a large number of existing staff; total integration of the student in the professional life; assurance that training budgets are spent on training.

The participants to the training project: staff of road and bridge sector in Romania having a technical, mechanical, economic and other background. They may come from NAR's regional divisions, central office, country road administrations, private sector etc.

The main fields of training in which the methodology of distance learning is concentrated in order to meet NAR's needs are as follows:

1. **Highway Design and Construction basic course**
2. **Highway Maintenance and Rehabilitation**
3. **Highway Materials and Testing**
4. **Bridge Inspection and Maintenance**
5. **Traffic Safety and Signalization**

The basic course is taken by all the participants in distance learning system, followed by a second specific course that is recommended by the tutor in accordance to the specific work that each student actually performs.

TUCEB provides: local management and administration for distance learning programme; technical coordination control; the development and production of the courseware; install and monitor programme quality control; course validation and accreditation; technical facilities; management of local training needs surveyors.

NAR provides technical expertise for courseware development; local tutors; transport and other expenses for trainees and NAR's staff.

On the basis of periodical tests and final examinations, the trainees are conferred a Certificate of completion of the course in which the obtained grades are written. The Certificate is awarded by The Technical University of Civil Engineering Bucharest together with the Road and Bridge Professional Association.

BALANCING TRADITIONAL AND NEW EDUCATION APPROACHES WITHIN A POSTGRADUATE PROGRAMME IN ENVIRONMENTAL PROTECTION AND SUSTAINABLE DEVELOPMENT

Pericles Latinopoulos[1]

ABSTRACT: *The Faculty of Civil Engineering of the Aristotle University of Thessaloniki launched in 1998 a one-year postgraduate programme in 'Environmental Protection and Sustainable Development'. Among other objectives, the programme complements the Faculty's traditional undergraduate curriculum by introducing these modern disciplines and, at the same time, the new concepts and ethics that relate to environmental engineering. In the paper the presentation of the programme's elements and functions and the discussion about the factors and conditions that had specific influences on them concludes a critical overview of the old and new ethics in engineering culture as well as a review of current trends in educational approaches related to environmental protection and sustainability issues. Given the solid nature of the civil engineering education obtained by the Faculty's traditional five-year undergraduate programme, the challenge to shift immediately to the new paradigm of contemporary environmental education programmes, in structuring the short-duration postgraduate programme, was given a careful consideration. The final decision was a rather moderate one, as the Faculty opted for a flexible course balancing traditional and new educational approaches.*

1. INTRODUCTION

The importance of environmental protection and sustainable development has been clearly recognised by the majority of the countries in the world. Still, in order to save the planet from an ecological disaster and also to provide future generations with a more fair distribution of the natural wealth, an active participation of all political and economic systems is required. In most places the battle to balance increasing economic growth with environmental conservation constitutes an ongoing dynamic process, so that it is difficult to foresee potential winners and losers. Sustainable development, the principal goal of this international movement, has been the focus of high attention within the European Communities for many years, but officially since 1992, when the Commission published the programme of policy and action in relation to the environment and sustainable development. The progress of this programme is continuously under review, a fact that shows the high interest placed upon it by the member-states (European Commission, 1997, 1998). Similar efforts, i.e. to help countries achieve the transition to sustainable development, are being observed also at a larger scale. OECD and its affiliates constitute a typical example of such a collective action towards the general aim of harmonisation and integration of relevant policies within an overall economic framework (Eppel, 1999).

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Current action of big organisations on sustainable development encompasses the full range of their activities, including education. In fact the promotion of environmental education, public awareness and training during the last decade has been greatly influenced by the outcomes of the United Nations Conference on Environment and Development, which took place in Rio in 1992, and especially by Agenda 21. Public awareness of environmental conservation and sustainable development depends on both formal and non-formal types of environmental education provided to all people; still in our case the interest is placed upon the environmental education that is provided to those who are, or soon will be, active professionals in related fields.

Briefly commenting on the environmental education at the general level (i.e. the non-formal type), one should note that its wide acknowledgement as an important tool in the environmental conservation process is not enough; it should be followed within each country by a full promotion at the national level, despite difficulties or even barriers of various forms (Filho, 1996). As an example, non-formal environmental education for adults, involving both cognitive development and personal empowerment, can be a valuable tool for resource and environmental managers to use in managing public investment processes (Diduck, 1999). On the other hand, when speaking of specific roles of individuals, the problem confines to the higher education institutions themselves, whose response to this big issue for the years to come should be given the highest priority in their strategic plans. Educating for the environment is indeed a challenge for the 21st century, but the response to it is still slow and, therefore, it should be soon accelerated, mainly through immediate rethinking current educational statuses (Orr, 1995).

Within the framework of the above, this paper attempts to contribute to the discussion about the means and instruments that should be used for the enhancement of environmental education at the university level. To this end, in what follows, the differences in ethics between a traditionally educated civil engineer and an environmental engineer are first presented, followed by a review on current educational concepts and approaches related to environmental management and sustainability issues. The emphasis is placed upon the transition stage, i.e. on how to shift from traditional to new approaches, given the fact that society is urgently looking for new type of engineers to serve its current and particularly its future needs.

The case study that concludes the paper refers to a postgraduate programme of study in '*Environmental Protection and Sustainable Development*' that was recently launched by the Faculty of Civil Engineering of the Aristotle University of Thessaloniki. Within its specific scope, the present paper is a follow-up of a previous publication (Latinopoulos, 2000), both papers being authored by the Director of Studies of the above programme. In this sense, the discussion that follows revolves around factors and conditions that have influenced the structure and contents of the novel and ambitious postgraduate programme which, among its other objectives, aims at complementing a conservative, traditional, and of long duration undergraduate curriculum of civil engineering.

2. OLD AND NEW ETHICS IN ENGINEERING CULTURE

2.1 The traditional engineering culture

In order to answer the fundamental question, whether there is such a thing as an engineering ethic, one has to trace back to history of the profession of engineering. Even by this way, engineering culture has to be examined from several perspectives, before reaching a final answer (Marsh, 1997). However, what is certain is that, historically, engineers had always a key role in economic development and for many periods of time engineering has been a principal agent of development in its general sense. Still, the engineering profession differs markedly from other human service professions in that it deals with objects that do not influence people directly, a fact that is mainly due to the considerable negative social and environmental impacts of technology. Moreover, for ages, numerous engineers were, and still are, too focused on the technical part of their work so that, although they know that they have a significant role to play, eventually they fail to fully understand their place in society.

The factors that limit the ideological development of engineering have deep roots, as they relate to intrinsic features, like a strong faith in pure technology, a collective professional consciousness without the ability of introspection, the inability to critically assess the role of engineers in society, and an overall belief and pride that current engineering principles can always provide the basic tools to reach the best solution of any problem. In general, engineers do not clearly understand that their attitudes and values greatly influence their approach to problems. This is one more factor that adds to the general picture of a conservative profession and subculture with its own social processes for maintaining traditional values and ideologies (Marsh, 1997).

There are various theories, most of them originating from sociologists, that can be utilised to formulate models which are capable to describe the ideological development of professions. So, the functional model of professions suggests that norms and values of the engineering profession are developed during long periods of training. Such training is mainly obtained during university studies, but it can be further emphasised by the inclusion of professional training and contact with professional peers. Still, specific research into the engineering profession demonstrates that, besides from the school model and the work environment model, which together form the traditional functional model, there is a third model that adds significantly to this development (Makkai, 1991). This third model, namely the social origins model, argues that the individual's origins and predisposition prior to university training constitute a significant force in determining later values.

In the face of the current rigidity of attitudes and values, recognised in the engineering profession, and given the complexity of the origin of such a culture, the emergence of environmental engineering poses a series of questions basically on how engineers can deal with the concepts of environmental protection and ecologically sustainable development. There are many ways to look for realistic answers to these questions. But, above all, it is certain that a new culture, that is a change in the engineering ethic, is required for those who will be professionally involved in environmental issues, particularly as environmental experts (i.e. biologists, ecologists, chemists and engineers). The most efficient approach seems to be that one which promotes education as the best model for such a change in the profession of engineering. Thus, before proceeding to the review of several aspects of such a process, we have to refer briefly to the main issues of these two major concepts.

2.2 The concepts of environmental protection and sustainable development

One of the most challenging priorities governments face today is to apply much of the pressure that will move modern society onto a sustainable path. Still, the magnitude and complexity involved in the major structural changes on economies, that governments should force in order to achieve this task, makes their planning a very difficult process. A feasible approach, though, may come from the world markets, that is those who helped make the Industrial and Information Revolutions possible, but also those whose failure to properly allocate natural resources and efficiently use energy sources resulted in numerous environmental problems. Indeed, these markets can guide the next revolution toward sustainability by enforcing economic instruments, like the "*polluter pays principle*", while at the same time supporting and promoting the development of new clean technologies (Roodman, 1999).

Of particular interest, as far as the concept of environmental protection and, more specifically, of pollution prevention is concerned, is the current trend in most developed countries to promote the preventive approaches instead of the traditional reactive ones. The well-known command and control approach, in which the reactive control model is dominating, used to give priority to technological fixes despite their cost. Initiated in the USA at the beginning of 90's, national policies in developed countries changed to pollution prevention or reduction at the source whenever feasible.

The concept of sustainable development, since the so-called Brundtland Report, became the central notion for politicians, ecologists and economists. In the Report, a sustainable development was defined as the development that provides for the needs of the present generation without endangering the possibilities for future generations to provide for their needs. This broad but clear definition leads to the need for a more detailed analysis of the concept of sustainability, which can be accomplished by appropriately considering the four principal dimensions: the ecological, the economic, the social-political, and the cultural dimension.

From the point of view of engineering, particularly civil and environmental, it is obvious that, from the above four dimensions, the economic dimension is the most interesting one, closely followed by the ecological dimension. Thus, speaking of sustainable development, one must choose between two concepts: (a) weak sustainability, which is satisfied if losses of natural capital are compensated for by increases in man-made capital of equal value, and (b) strong sustainability, which requires that aggregate natural capital does not decrease. Before deciding, a very careful analysis is needed, because the notion of sustainable development is subject to environmental standards imposed on decision-making. Thus, it should be always kept in mind that these standards (e.g. to safeguarding the atmosphere, protecting biodiversity and so on) cannot be traded off against each other and cannot be expressed in terms of money valuations (Bowers, 1997).

3. CONCEPTS AND TRENDS IN ENVIRONMENTAL EDUCATION

3.1 Issues in environmental education

At the dawn of the 21st century the issues of environmental protection and sustainable development can be classified among the most challenging subjects for educators of all stages. A major target is to materialize through education the ecological or environmental literacy, an overall ability to connect, to synthesise knowledge from the gamut of disciplines, in order to see the big picture (Roodman, 1999). This implies that students should be able not only to understand the physical processes but also to think how these processes shape global phenomena of non-physical nature, like economy and geopolitics. Thus, properly trained environmental engineers can be also characterised as environmentally literate only if they have the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems.

With a few exceptions, institutions of higher education in engineering disconnect disciplines and insist on teaching technology as if it were the only way to the solution of environmental problems. The reasons for such an attitude can be summarised in the following (Orr, 1995):

- The organisation of both curricula and research in a fragmented way, i.e., based on disciplines, sub-disciplines and departments, each dealing only with small pieces of the total picture.
- The rise of discipline-based professionalisations, a fact that, for the sake of gains in standards and quantity in knowledge, narrows the focus of scientists on subjects within particular fields.
- The slow, if any, response of higher education institutions to the environmental crisis and their fixation to ideas that serve task-oriented propagation of knowledge, which very vaguely fits with our responsibility for the earth.

What actually should be done is rethinking the fundamental principles of higher education, and more specifically, rethinking the conventional curriculum. The last relates to rethinking how institutions operate, buy, invest and build. The design of an environmental education programme must be synonymous to ecological design, in the sense of connecting disciplines and of incorporating intelligence about how nature works into the way we build, produce and, above all, live (Orr, 1995).

In its general meaning sustainability seeks to continue to meet current demands, without infringing on, or compromising the needs of future generations, by promoting optimal use of resources and energy. Thus, among various issues brought in by sustainability, one can distinguish those of resources and energy conservation and pollution prevention as the ones that are firmly connected to engineering. As a consequence, an environmental educational programme run by an engineering faculty should incorporate the issue of sustainability in its course structure through a properly balanced curriculum that includes both technological advances and sustainability issues as the ones mentioned above (Dahab and Gutierrez-Martin, 1998).

As mentioned in the previous section, current action in environmental protection policies has been shifted from reactive approaches to preventive ones, the major task of this trend being to put into practice the concept of pollution prevention. Still, the relevant pace is yet slow and this is reflected also upon education. The principles of assimilative capacity and control theory are the critical issues around which environmental education curricula have largely been implicitly designed. What is now required, in order to teach preventive strategies, is a more systematic, strategic, interdisciplinary framework, in which students should be also provided with opportunities to feel responsible and comprehend value changes, as described in the next section. Recent experience shows that, at both the undergraduate and postgraduate levels, preventive environmental education curricula are not only feasible but also very promising (Simpson and Budd, 1996).

3.2 Educational approaches and methods

Within a general context and in order to achieve the target of creating environmentally literate graduates, environmental education has to be seen as if consisting of some or all of the following stages: (a) raising awareness, (b) knowledge and understanding, (c) skills, (d) attitudes and values, and (e) action. In practice, none of them should be separated from the rest because of their inter-relationship; nor should they be seen as a series of stages to be reached in succession (e.g., from awareness to action, as above). By tradition and basically following standards that are common in other related curricula, like the engineering ones, typical classroom environmental education concentrates mainly on knowledge and skills and partly on awareness and action. This inclination towards the use of cognitive domain education methods predominates for years in many undergraduate and postgraduate programmes, while only little emphasis has been put on the affective domain education methods (i.e., the methods which can be used to examine attitudes and values related to environmental issues).

Recent experience shows that environmental education could be today characterised by an emerging preference for the affective domain, as many environmental educators are ready to adopt a values-education approach to teaching. Still, there are many questions regarding the best way to incorporating such an approach into environmental curricula, in order to achieve the goal of developing environmentally literate citizens. Development of environmental conceptions that embed environmental knowledge, attitudes and values, and behavioral orientations are still in their early youth (van der Vorst, 1997) or even in the form of theoretical models (Ballantyne and Parker, 1996), and a lot of research is required to enable environmental educators in designing more effective relevant teaching and learning methodologies. Particularly in the case of environmental engineering education, the change from the traditional engineering programmes is actually a change of culture, a cultivation of new engineering ethic (Marsh, 1997).

Of special interest, when designing an environmental programme’s course structure, is to consider the value of using each of the education methods in teaching at the same time about, through and for the environment, that is implementing both the cognitive and affective domain approaches. Experience from various classrooms shows that, among cognitive domain methods, problem solving/critical thinking is nowadays a much preferred education method, whereas cooperative learning and observation, experiments etc. are also valuable methods, as contrasted to the classical forms of self-directed learning, case studies and formal classroom lectures. Among affective domain education methods, action learning, awareness activities and moral development activities are much favored by students in environmental programmes. This reality should be given careful consideration by individual teachers as well as by faculties during the process of designing new or reviewing existing environmental curricula.

Finally, speaking of the educational process, one should realise that it needs specific management. Managing the educational process combines the development of a well-defined plan with the proper use and training of all available resources and particularly of the human resource. At the faculty level, the design of an effective education programme calls upon faculty members who are properly trained, or at least well experienced, in designing such programmes, strategic planning and faculty development (Russel et al., 1997). At the end, a successful education programme is the result, among others, of a properly designed and effective educational process that is continuously managed by experienced faculty members.

4. THE POSTGRADUATE PROGRAMME

4.1 Background and objectives

The Faculty of Civil Engineering of the Aristotle University of Thessaloniki was established in 1955 and is the oldest of the seven faculties within the School of Technology. After a major reform in the higher education legislation in Greece that took place in 1982, the Faculty was practically reconstructed and formed an autonomous unit that awards the Diploma of Civil Engineering after completion of a five-year undergraduate programme. Aligned with typical international trends at that time, the Faculty was partitioned into four divisions: (a) Structural Engineering, (b) Hydraulics and Environmental Engineering, (c) Geotechnical Engineering and (d) Transport and Organisation.

Both the above described administrative structure of the Faculty and the structure and content of its undergraduate curriculum mark a traditionally oriented Civil Engineering education approach. Following the classification adopted in a recent survey, carried out within the activities of a Socrates-Erasmus thematic network project called "*European Civil Engineering Education and Training"* (EUCEET), the undergraduate programme of the Faculty belongs to the so-called continental system – as opposed to the anglo-saxon one – and particularly to the category of programmes of long duration, i.e. from 4.5 to 6 years (Manoliu and Bugnariu, 2001). The distribution of various categories of subjects (namely Basic Sciences, Engineering Sciences, Core Civil Engineering Subjects, Engineering Specialisation and Non-Engineering Subjects), taught along its five-year curriculum, was found to be very close to the average distribution in its own category of programmes, as calculated in the analysis that concluded the above questionnaire survey. The typical as well as traditional structure of the undergraduate programme was confirmed even by its average value of contact hours per week (26.1) that is almost identical to the mean value of the corresponding statistic of the relevant faculties sample (26.8).

Until recently the Faculty was offering only one postgraduate programme leading to a PhD degree. To catch up with rapid developments in civil engineering education, but also to serve current and future societal needs, the Faculty launched in 1998 two one-year postgraduate programmes in the areas of Environment and Earthquake Engineering, respectively. Common objectives of the programmes are: (a) to offer scientific training and specialisation to engineers and scientists within a rather short period of time, (b) to provide them with the necessary background and technical knowledge related to complex, still practical, problems, creating thus individuals capable for a successful career in both the public and private sectors, and (c) to prepare highly-qualified students for entry into the doctorate (PhD) programme of the Faculty of Civil Engineering.

Particular objectives of the postgraduate study course in "*Environmental Protection and Sustainable Development*" are to provide students with the scientific and professional knowledge that is necessary for their field of interest and to develop their abilities to formulate solutions to various problems in the context of current environmental and related socio-economics considerations. These objectives are accomplished by offering a flexible course structure that mixes both traditional and modern educational approaches dealing with the protection of the environment and the integrated sustainable management of civil engineering projects. The programme has been designed so that, after completion, the graduate will:

- acquire a high-quality knowledge of all issues related to environmental protection and sustainable development;
- get familiar with existing institutional and legal framework in Greece and in the European Union;
- be able to analyse, investigate and manage any project related to the theme issues;
- be able to develop environment-friendly policies and become a policy-maker with a full responsibility for his/her role toward the society.

An added value of the present programme is that it is the only one-year postgraduate course, offered by a Greek faculty, that integrates civil engineering technology, environmental protection and sustainable development. Although the issues of environmental protection and sustainable development are of great importance in the country, environmental education at the university level is seldom offered in Greece, at least in the form of autonomous programmes. At the undergraduate level there are only 3 faculties in the country that are fully devoted to environmental education: two of them - at the Democritus University of Thrace and the Technical University of Crete - offer five-year environmental engineering degree programmes while the third, at the University of Aegean, offers a four-year environmental science degree programme. On the other hand, among approximately 200 postgraduate programmes in all fields, offered by various faculties of the 17 Greek Universities, 20 are dealing in various ways with environmental issues and only 3 of them are offered by engineering faculties (at the Aristotle University of Thessaloniki, the National Technical University of Athens and the Technical University of Crete).

4.2 Structure and contents

The Postgraduate Diploma of the programme is granted after completion of one full year of study, which breaks up into two semesters totaling a 9-month teaching period, during which the course units listed in Table 1 are being taught, and a 3-month summer term devoted to thesis preparation. Successful completion of at least 9 course units is a prerequisite (i.e. the four compulsory course units of the 1st semester and any five from the elective course units of the 2nd semester).

Table 1 The content of the programme

Core course units (1st semester)	Elective course units (2nd semester)	
• Environmental Assessment and Management	• Sustainable Management of Water Resources	• Urban – Land Planning and Sustainable Development
• Natural Resource and Environmental Economics	• Protection and Restoration of Groundwater	• Protection and Sustainable Development of Coastal Zones
• Decision and Risk Analysis	• Management of Liquid and Solid Wastes	• Protection of the Marine Environment
• Acquisition, Processing and Management of Environmental Data	• Transportation – Transport Policy and the Environment	• Environmental and Energy Approach to Buildings
	• Environmental Management of Transportation Projects	• Environmental Geotechnology
		• Management of Natural Hazards

Following most of the concepts and trends mentioned previously, the programme's structure is designed so that: (a) Core course units cover the general theories, approaches and techniques, whereas elective course units constitute a group of specialisation topics. (b) The issues of sustainability and environmental protection are embedded into several course units, while corrective actions, both at the policy and technology levels, are emphasised in the more traditional engineering topics. (c) The educational process is a mixture of various methods, many of which originating from within the cognitive domain, in an attempt to conform, at least for the first years of the programme's operation, with long-existing habits but, on the other hand, to challenge both teachers and students toward the new teaching paradigms.

4.3 Educational process and resources

Although the Division of Hydraulics and Environmental Engineering holds the major part in teaching and research activities of the programme, practically all divisions of the Faculty participate in it. Well-equipped laboratories of the divisions support the training of students in various fields. Computer facilities of the Faculty include a local network of numerous workstations and PCs, which are connected to the Aristotle University campus computer network. The new library of the Faculty is another useful resource on its own and also the gate to the university's main library. Furthermore, recent developments in educational methods, and particularly the introduction of educational software and multimedia in the teaching and learning processes (OECD, 1998), kept the Faculty busy for the last two years in an attempt to adopt to the impact of information technology. One of the most valuable products from this activity is the Faculty's Electronic Educational Library, a multi-purpose electronic system aiming to improve teaching methods through multimedia applications (Avdelas and Latinopoulos, 1999).

Teaching material, especially of the type of commercial educational software, has been also purchased and installed in the local computer networks of the Faculty in order to serve the specific needs of the postgraduate programme. In addition, following current trends in classroom teaching with notebook computers (Neu, 1998) and in order to enhance presentations and learning efficiency, original educational material was produced by some of the instructors. As already has been noted in various higher education courses related to Environmental Science (e.g. Lowry, 1999), lecturing with the aid of suitable software, like PowerPoint, could significantly benefit students' performance. In addition to this option, other types of instructional material used in the programme include videos and slides collections on environmental educational topics. These topics were carefully selected, so that their contents are aligned with national standards and problems of interest, with course units of the programme and also with needs and interests of the students.

The high-level status of the material resources described above is being harmonically coupled with the human resources of the Faculty to form its overall teaching and learning potential. Moreover, a long experience of the Faculty staff, and particularly of the 20 professors affiliated with this programme, adds to an equally significant research potential. Most members of the Faculty staff are specialists in their respective fields and participate in numerous research programmes of the Faculty as well as in funded research undertaken in cooperation with industry and public authorities and agencies, both at the national and the international level. Given the particular characteristics required in enhancing advanced environmental education, especially when, as described in previous sections, such a training is to be provided to traditionally trained civil engineers, the research potential of the teaching staff is an added benefit to the postgraduate programme at hand. This is best seen in the production of various research reports, which constitutes an integral part of the whole educational process. Such an activity, when is supervised by qualified researchers, can help in developing individuals (i.e. the students) with sound-problem solving and decision-making skills.

Summarising the above, it can be argued that the described educational approach is similar to typical new models of environmental education which require a mixture of three sectors, namely Technology Knowledge, Transferable Skills and Attitude, in order to obtain the desired learning outcome (van der Vorst, 1997). This is because the teaching methods and media, which should be used to create such an outcome (i.e. lectures, tutorials, seminars, laboratories, projects, information technology, books, independent study, group work, discussion groups, and field trips and visits), were all implemented in the postgraduate programme. What makes the difference from the most innovative programmes is the priority given in the present course to more traditional methods (i.e. cognitive methods for technology and skills) against the affective methods, which promote related attitudes.

4.4 Implementation and assessment

The Faculty of Civil Engineering has continuously operated the postgraduate programme in "*Environmental Protection and Sustainable Development*" since September 1998. During these three academic years demand for the 30 places offered has been high, as the number of applicants ranged from 100 to 140. Nevertheless, evaluating the success of an environmental engineering program is a complex and, thus, difficult task that cannot be based on demand figures alone (Marsh, 1997). This is because these figures are biased by various factors such as fashion, inadequate supply of similar programmes, potentially strong job prospects etc. Therefore, a preliminary evaluation of the programme was carried out in order to reconfirm the rather apparent intrinsic values offered by it and, most of all, to assess the soundness of its original design and implementation concepts and practicalities.

The programme's evaluation process consisted of three parts: (a) a students evaluation survey, (b) a teachers self-assessment procedure, and (c) an overall assessment of the programme by two external evaluators, invited from foreign universities. Results from the first year's (i.e., academic year 1998-99) assessment can be summarised in the following:

- A prime feature was the enthousiasm of the programme's designers but also of the teachers and students. This was mainly due to the fact that, for Greek conditions, it is a new and innovative study course that deals with a very important subject.
- The programme proved to be well structured and effective in its whole, regarding the students' attraction to the contents of the course topics as well as the implied teaching and learning methodologies. A direct proof for this is the fact that all elective course units were selected and successfully completed by more than seven students.
- Responses from students, collected during and after completion of the programme, confirmed the usefulness of a well-balanced curriculum (i.e. traditional versus new educational subjects) while, at the same time, underlined their inclination towards the non-classical forms of teaching and learning.
- The external evaluators agreed that the overall design of the programme meets very successfully the international standards of higher education studies in relevant disciplines and that it has great prospects toward its future development.

5. CONCLUSIONS

The new postgraduate programme in "*Environmental Protection and Sustainable Development*", offered by the Faculty of Civil Engineering in Thessaloniki (Greece) proved to be an interesting and also a valuable experience for all Faculty members who were involved in its design and operation. Based on current concepts and trends in environmental engineering education and structured upon the Faculty's teaching and research potential, the programme looks very promising when considering the following factors: (a) the rather essential gap in this specific area of higher education within a country which strives to meet the forthcoming challenges of the 21^{st} century, (b) the proper design of the programme, including the optimal utilisation of all the Faculty's resources, and (c) the enthusiasm with which educators and students were filled during the first time of the programme's operation.

What is to be seen in the near future is whether the specific model that was initially selected by the Faculty, and particularly the balancing of traditional and new educational approaches, can foster the new ethic required in the profession of environmental engineering, and (why not?) of civil engineering. The preceding review and discussion of the various issues and concepts that relate to the constraints which should be met in order to accomplish the task for a new culture, and the consequent full shift to the new paradigm, shows that further changes may be needed not only within the postgraduate programme at hand but also in the Faculty's undergraduate curriculum.

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REHABILITATION ENGINEERING – AN INTERNATIONAL MASTER PROGRAMME AT THE DRESDEN UNIVERSITY OF TECHNOLOGY

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ABSTRACT: *Internationalization of the higher education system has been an aim of the German government over the last years. In this paper, several forms of cooperation such as "International quality networks" and "Internationally-oriented courses of study" are introduced. At the same time, new challenges to the civil engineering profession arise from transformations of national economies and an increasing public interest in the preservation of unique historical areas. In this context, the professional relevance of rehabilitation engineering is demonstrated. In addition, general conditions, concepts and content of an English-language Master programme "Rehabilitation Engineering" are presented.*

1. BACKGROUND

Internationalization of the higher education system has been a strong intention of the German government over the last years. Within the scope of the "*Initiative for the future of higher educational institutions*" encouraged by the ministry of education and research, a new programme of the German Academic Exchange Service called "*International quality networks*" has been launched at the end of the year 2000. One of the main objectives of this programme is to increase incorporation of highly qualified academics, graduates and students from abroad into research and teaching activities at German universities and advanced technical colleges. Cooperative networks between first-rate foreign partners will make a substantial contribution to the internationalization of higher educational institutions.

Different funds are integrated into the "*International quality networks*" – programme, such that universities and their partners can organize various forms of exchange individually. Thus, greatest possible synergetic effects can be achieved.

The "*International quality networks*" – programme is aimed at multilateral cooperations between a manageable number of prestigious foreign partners. The incorporation of external, German and foreign research institutes is desirable. Departments, faculties or whole universities pursuing one concept coherent in content can be supported within the scope of the "International quality networks" programme. The following measures can be combined within one "*International quality network*":

- grants for students from abroad, up to two years for Master courses exhibiting an international dimension preferably
- grants for foreign doctorate students
- post-doc positions and research groups
- guest lecturers from abroad

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- exchanges related to specific projects
- attendance, extra costs, marketing

In parallel with the initiatives described above, another programme called "*Internationally-oriented courses of study*" has been announced by the German Academic Exchange Service last year. Within the scope of this programme, ten international courses will be promoted by the German ministry of education and research per year. These courses should, in any case, be designed for German and foreign students, exhibit a foreign-language component and enable the aquisition of an internationally compatible degree within an average period of study. The major objectives of the programme mentioned above are to increase attractiveness of studying in Germany for qualified foreign pupils and to add a multilingual, international dimension to professional education.

The following general set-up has been defined by the German Academic Exchange Service:

In the first place, two-stage courses of study showing a consecutive structure will be supported. Master courses will be accepted on condition that acquisition of a corresponding Bachelor degree is possible at the same institution. Furthermore, the possibility of attaining a degree of international compatibility within an average period of study should be guaranteed. The international course under consideration has to be accredited as a result of an evaluation procedure during the first period of promotion.

An approximate number of 40 – 60 participants, half of them coming from abroad, should be admitted per year. National origin of the participants should not be restricted to EU countries.

Another essential prerequisite is the use of a foreign language – English in the first place – as a means of teaching and working. To realize this condition in an optimal way, part of the academic staff should be native speakers. Examinations should be held in either of the two languages, alternatively. Certificates and diplomas should be issued in both German and English version.

A stay abroad in connection with a practical training or university education for a period of one to two semesters should be compulsory for all students. Results and certificates attained during this period have to be fully acknowledged by the home university and should be converted according to a credit system similar to the European Credit Transfer System (ECTS).

In order to ensure the knowledge of the foreign and German language needed by the participants, universities are urged to provide preparatory and accompanying language courses. In addition, welfare services should be made available in order to guarantee the social and professional integration of foreign participants.

To sum up, one may say that the German government is highly aiming at internationalization of the higher education system. To facilitate this intention a number of programmes has been launched which support the setting-up of international courses of study at German universities and advanced technical colleges. In this context, a new Master programme "*Rehabilitation Engineering*" is established at the Faculty of Civil Engineering of the Dresden University of Technology. Apart from its international dimension, this course is designed to enhance the quality of civil engineering education with respect to new demands arising from drastic changes in national economies and social structures. In the next section, the professional relevance of rehabilitation engineering will be explained. Afterwards, general conditions, concepts and content of this English-language programme will be presented in more detail.

2. PROFESSIONAL RELEVANCE OF REHABILITATION ENGINEERING

Today, national economies are experiencing serious transformations due to drastic politic upheavals. At the same time, the economic and social structures in all parts of the world are undergoing permanent changes. Therefore, a continuous adaptation of urban and rural settlement and communication areas is needed. In this connection, enormous challenges to the civil engineering profession arise:

Unique townscapes have to be regenerated, single world-famous architectural ensembles have to be preserved and put to new use. The existing infrastructure has to be adjusted to the demands or renewed completely, if necessary.

These tasks call for extended civil engineering skills that go beyond the knowledge needed for the construction of buildings in structural, underground, tunnel, water or road engineering and other fields of civil engineering. For example, before the refurbishment of a historical building can take place, all technical, artistic, cultural and social boundary conditions of the period of origin have to be investigated. This is followed by an assessment of the actual conditions in order to derive necessary measures for rehabilitation, renewal or re-use of the building. Finally, special construction methods and economic strategies are needed to put these measures into action.

The tasks described above gave rise to the establishment of the collaborative research centre "*Textile reinforcement for structural strengthening and repair*" in 1999 already. Furthermore, the Faculty of Civil Engineering at the Dresden University of Technology has been involved in a number of projects related to the subject rehabilitation engineering. A selection of those is given below:

- Load-bearing capacity of historical buildings
- Maintenance of historical buildings
- Experimental assessment of in-situ load-bearing capacities of structures for the purpose of preservation or re-use
- Enhancement of methods for the diagnosis and treatment of critical masonry parts in architectural monuments
- Maintenance strategies
- Recycling of building materials

In order to enhance the quality of civil engineering education with respect to the above-mentioned demands and to promote an international understanding, a new Master programme "*Rehabilitation Engineering*" is established at the Dresden University of Technology. Based on its expert knowledge gained in Dresden as an international centre of culture and art, in connection with a number of buildings of historical value and associated rehabilitation projects of magnitude of thousands of millions EURO, the Faculty of Civil Engineering seems to be predestinated to set up such a programme.

3. STRUCTURE OF THE COURSE

The internationally-oriented programme "*Rehabilitation Engineering*" represents an independent English-language course of study which is self-contained and forms a unified whole.

Prerequisites

German students require successfull completion of the main studies of a university course in civil engineering.

Graduates from advanced technical colleges are admitted in accordance with the current course regulations.

Applicants from abroad should provide a Bachelor degree, as a rule.

Programme

During the first and second semester English-language lectures and tutorials will be held. These will be complemented by homework, course-work and excursions. In addition, accompanying German language courses will be offered.

During the third semester, students are supposed to work on an individual project. Some accompanying lectures will take place, also. German participants are principally expected to accomplish this period of study abroad. Foreign participants may spend the third semester in Germany, also.

The programme will be completed by intensive courses and seminars during the fourth semester. Students will graduate after submitting a Master thesis and passing a final examination.

Degree

Graduates of the above Master programme will be awarded a Master degree. Students who completed the basic and main studies of a civil engineering course followed by the internationally-oriented programme "*Rehabilitation Engineering*" consecutively, will be awarded the German diploma of the Faculty of Civil Engineering of the Dresden University of Technology at the same time.

4. INTERNATIONAL DIMENSION

Language

During the first two semesters all lectures and tutorials will be held in English, in principle. Only elementary knowledge of the German language will be required by the foreign participants. However, intensive German courses will be compulsory during the first two semesters in order to facilitate continuous integration into the German linguistic standard and social community. German participants will be referred to preparatory courses of technical English.

The Master thesis has to be written in English. However, the oral presentation of the results should not be held in the native language of the candidate.

Altogether, there are 25 professors teaching at the Faculty of Civil Engineering of the Dresden University of Technology. The majority of them has extensive foreign experience due to international cooperations. Moreover, several lecturers have gained teaching and professional experience while working in an English-language country. Today, publications are written in English predominantly. As a result of European integration, English has become a general means of communication in civil engineering, also. Some of the partner universities of the Faculty of Civil Engineering of the Dresden University of Technology, such as the ones in Budapest, Florence and Prague, have established continuous English-language periods of study already. These contacts facilitate the organization of periods of study abroad.

Stay abroad

German participants are principally expected to spend the third semester of the Master course in a foreign country. Foreign students are free to choose their place of study.

The project worked on during the third semester should focus thematically on "Rehabilitation and cultural heritage". In this connection, existing contacts to the universities of Florence, Prague, Wroclaw, Budapest and Lyon will be beneficial. These contacts are a result of bilateral scientific cooperations and major projects within the scope of EU programmes.

All marks and results obtained during this period of study will be evaluated according to a credit system. Here, experience gained in connection with the exchanges under the auspices of the Socrates / Erasmus programme will be of value.

Cosmopolitan outlook

The Master course is directed at interested people from all over the world and is open to everybody providing the respective qualifications. Special contacts of the Faculty of Civil Engineering to countries outside Europe, such as Vietnam, Thailand, Syria and Ethiopia, will be beneficial for the non-European marketing. These contacts are based on professional cooperations and discussions within the scope of binational agreements as well as on studies of foreigners in Dresden. All of these contacts are thematically related to the range of problems associated with the field of rehabilitation engineering. For example, the project pursued in Hanoi deals with the upkeep of the historical part of the town together with the simultaneous improvement of the infrastructure in the widest sense and the preservation of buildings from environmental pollution. On the other hand, exchange students coming from Florence have been working on projects related to the reconstruction of the Frauenkirche in Dresden.

On EU-level there are 17 agreements within the scope of the Socrates programme which have been seized by German students with high involvement, so far. The opposite way of foreign students coming to Dresden has been impeded by language barriers up to now.

Professional profile

As presented above, an exceptionally wide professional field will be open to graduates of the course described above. The upkeep and continuous renewal of historical buildings together with economically reasonable forms of use are decisive tasks for civil engineers and an essential prerequisite for the preservation of urban estates worth living. The public awareness of the uniqueness of historical areas is increasing constantly. Today, it is of public interest which buildings and urban estates are listed by the UNESCO and many communities and public institutions are aiming to become part of the cultural heritage. The following examples may illustrate the national importance and international radiation of building projects exhibiting a historical relation:

- Frauenkirche in Dresden
- Church Hagia Sophia in Istanbul

- Cupola of the Cathedral in Florence
- Colosseum
- Tower of Pisa
- Pyramids of Chephren
- Tilla Kari Mosque in Samarkand
- Temples of Angkor and Konarak

- to name only a few ... All these measures are coupled with an enormous number of technical and civil engineering problems. This begins with questions related to building materials and ends with negative effects caused by traffic induced vibrations, building operations and earthquakes.

Social and professional care

The International Office of the Dresden University of Technology has been offering a huge number of events for the integration of foreign students, already. Today, there are about 26000 students at the university, 1500 of them coming from abroad. Thus, a competent look-after can be guaranteed. In the future, at each chair a member of staff will be appointed as a "*personal adviser*" who will be available for help concerning professional matters. In special cases, lecturers with a knowledge of Russian or French language will also be available.

Due to the successfull cooperation between the International Office and the Students Welfare Service, providing accomodation has never been a problem and has always been realized to everyone's satisfaction.

Foreign-language and professional competence

Admission to the Master course follows after providing evidence of special knowledge of English language. For example, TOEFL-test results should exceed 550 points. Elementary knowledge of German language has to be proven by official certificates, also.

The internationally-oriented course of study is directed at highly motivated, capable students in the first place. Therefore, good marks (equivalent to grade B) will be a prerequisite for admission.

Excursions

Lectures will be completed by accompanying excursions into the Dresden area. There is a wealth of suitable objects available – ranging from single buildings to measures for the improvement of the infrastructure in the widest sense. The vicinity of the partner universities in Prague and Wroclaw facilitates organization of short trips into these regions blessed with plenty of historical monuments.

Guest lecturers

As a result of contacts established within the scope of the reconstruction of the Frauenkirche, there are connections with a number of outstanding personalities who have rendered enormous services to the subject of rehabilitation engineering. It is an aim to ask some of these colleagues to come to Dresden in order to present current rehabilitation projects.

5. CURRICULUM

A first design of the curriculum is given in table 1. Here, the major groups of specialization are listed together with the corresponding lecture times. The term "2 SWS" refers to a 90-minutes teaching unit held once every week.

Table 1. Curriculum of the Master Course "*Rehabilitation Engineering*" at the Faculty of Civil Engineering of the Dresden University of Technology

1st semester

Lectures and exercises

Structural Analysis, Materials and Design	:	14 SWS
Urban Engineering and Road Construction	:	2 SWS
Hydraulic Engineering	:	2 SWS
Construction Management	:	2 SWS
Building History	:	2 SWS

2nd semester

Lectures and exercises

Structural Analysis, Material and Design	:	9 SWS
Urban Engineering and Road Construction	:	4 SWS
Hydraulic Engineering	:	2 SWS
Construction Management	:	4 SWS
Environmental Engineering	:	3 SWS

3rd semester

Study abroad at partner universities – good contacts to Prague, Budapest, Wroclaw, Florence, Lyon will be activated. The main objective of this 3rd semester is to realize an engineering project accompanied by special related lectures including "Rehabilitation of Cultural Heritage".

4th semester

Seminar for presentation of 3rd semester projects.
Excursion during Whitsun break.
Advanced courses on subjects related to topics of Master thesis.
Elaboration and presentation of Master thesis. Final examination.

6. CONCLUSIONS

The introduction of an internationally-oriented Master Programme "*Rehabilitation Engineering*" at the Faculty of Civil Engineering would undoubtedly promote the internationalization of the Dresden University of Technology. At the same time, the quality of civil engineering education with respect to new demands arising from economical changes and an increasing public awareness of historical values would be enhanced tremendously. The plan to establish such a course has been judged positively, in principle by the German government. However, a final decision is yet awaited.

IS A PhD IN CIVIL ENGINEERING USEFUL?

Jean Berlamont[1]

ABSTRACT: *An enquiry was held among alumni of the KU Leuven, who obtained a PhD degree in engineering not more than 10 years ago to answer the questions: is a PhD in engineering useful? Should the subject be related to an industrial problem rather than to a purely scientific one? Should the research be conducted in industry rather than in a university laboratory?*
The conclusion was that a PhD in engineering is useful for industry, not because the doctors are better specialists or better engineers but because it guarantees a company that hires the doctor engineer that he/ she is a creative, hard working, well communicating individual. Apparently, it does not matter very much whether the research is carried out in industry or in a university laboratory; neither does the subject of the doctoral research, except in the rare cases where the job in industry is directly related to the research topic. There seems to be no need for two different doctoral degrees (a scientific and an industrial one). Most doctors in engineering would repeat this «once in a lifetime experience» which, according to them, completes the engineering education.

1. INTRODUCTION

About thirty years ago it was exceptional to meet a civil engineer holding a doctor's degree. Even university professors did not. For being eligible for becoming a faculty member it was required to have obtained a (advanced) master degree (preferably in the U.S.A.) and to prove professional experience. Nowadays, to be a successful candidate for an academic position, it is absolutely imperative to hold a doctor's degree (and to have enough international, peer reviewed publications). The number of doctoral degrees awarded at the engineering faculties increased dramatically during the last 20 years. At KULeuven, for example, the number of PhD's in engineering increased from 19 per year in 1982 to about 60 in 2000 (see fig. 1). The number of PhD's in civil engineering increased from an average of 1 per year in the 80's to 4 in 2000.

From the point of view of the Technical Universities or Engineering Faculties of general universities, this evolution is only but natural since the number of PhD degrees awarded (and the number of scientific publications that go with them) are considered to be a reliable measure of the scientific activity in the departments and is taken into account whenever financial and human resources are allocated to the departments.

Of course, not all doctors in engineering obtain faculty positions at the universities. That means that more and more of them go to industry. Therefore, over and over again, the question is asked whether a PhD degree is useful for industry, or whether PhD degrees are only useful for the university departments that award them.

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To find the answer to this question, an enquiry was held among about 300 engineering alumni of the KULeuven, who obtained their PhD not more than 10 years ago. About 200 answers were received. The results are analysed in the subsequent sections. Because the focus was on the «added value and benefit for industry», the answers obtained from doctors in engineering who in the mean time obtained tenure faculty positions were disregarded.

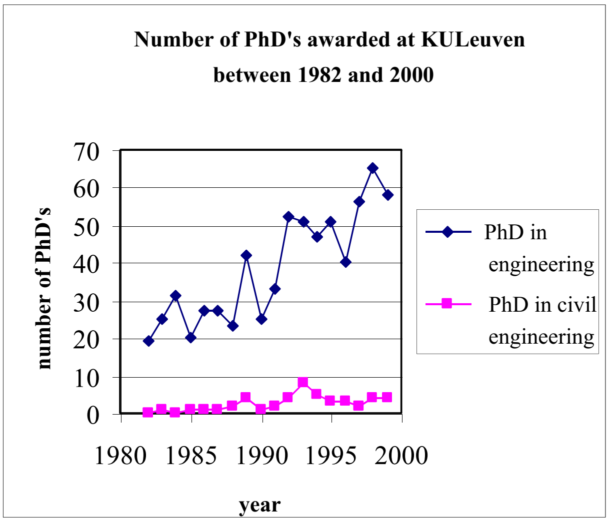

Figure 1 Evolution of the number of PhD degrees in engineering (and in civil engineering in particular) awarded at KU Leuven during the last 20 years

2. THE ENQUIRY

After discussion in the «scientific advisory board» of the faculty of engineering of KULeuven the following questions were formulated:

- Does a PhD degree in engineering offers an advantage for (civil) engineers who want to pursue a career in industry?
- Does the fact that a candidate for a position in industry has a PhD degree offers an advantage to the company that hires him/her? This is a particularly pertinent question in Belgium, where most of the industrial companies are small to medium size companies.
- Should more attention be paid to the «doctoral programme», i.e. the additional courses, seminars and other activities required as a prerequisite for obtaining the PhD degree?
- Should a new type of «doctorate in engineering» be introduced, which would be more focused on industrial problems than on a «purely» scientific subject? Should the research be (partly) conducted in industry rather than in a university laboratory?

3. DID YOUR PHD DEGREE SPEED UP YOUR CAREER IN INDUSTRY OR DID IT GUARANTEE YOU A «BETTER» POSITION?

The answers to this question diverged strongly, mostly depending on the department where the PhD was obtained. As far as the «better» job was concerned between 27% and 60% answered «yes», for the «faster» career the number of «yes» answers varied between 11% and 50 %!

It was not so very much the subject of the doctoral research that made the difference in the first place, but the research «field» within a particular engineering discipline.

Most respondents stated that, except for R & D (Research and Development) jobs, the position is not offered *because of* the PhD degree. Also the financial remuneration is not directly related to the PhD diploma. On the contrary, it is the experience gained during the doctoral research period and the complementary «formation» that allowed many to have a faster evolving career than engineers without a PhD, but having a lead of 4 to 6 years in the company.

The doctoral degree is first of all a «quality label» that guarantees the employer that the doctor in engineering can tackle complex problems, *both* technical and managerial ones. For most of the commercial, production and management jobs however, having a PhD degree does not necessarily provide an advantage, on the contrary: companies are rather restrained when hiring doctors for these jobs because they fear that they will not be able in the future to offer a job challenge that satisfies the professional ambition of the doctor in engineering.

4. ARE YOU BETTER PREPARED FOR YOUR ACTUAL JOB BECAUSE OF YOUR PHD RESEARCH? DID YOU GET THE JOB *BECAUSE OF* YOUR PHD DEGREE?

The number of «yes» answers to these questions varied between 33% and 75% for the first one, and between 33% and 55% for the second one.

Of course, having a PhD is a «must» for anyone who wants to pursue an international scientific career or a career at a University, but otherwise, when soliciting for a job, «personality» is a factor of much more importance.

It is in particular the additional «formation» gained during the doctoral research period that offers a competitive advantage to a doctor engineer for better accomplishing a particular job. Because a doctor has learnt to report in a systematic way and to present and defend his/ her research results at international conferences and project meetings with (equally ambitious) colleagues, he/she may gain the lead in (international) discussions and negotiations. The experience acquired can also be valuable e.g. when writing project formulations.

The dr. – title does guarantee the holder (international) respect and appreciation, which may offer advantages in a job situation. A certain disadvantage is however the fact that doctors often stay too long in a R & D job, preventing them to move on to a more rewarding management position.

5. DO YOU GET MORE RESPECT AND A BETTER FINANCIAL REMUNERATION BECAUSE OF YOUR PHD DEGREE?

The answers to this questions diverge a lot, and depend mainly on the type of company where the doctor in engineering works and his/ her position or function in the company. The answers may also be biased because dr.'s naturally belong to the 10% best students, and thus to a certain degree are «pre-selected».

The doctoral degree *as such* is not appreciated by industry. The experience gained during the doctoral research and the additional skills acquired are however highly valued. For that reason, more challenging (and rewarding) job opportunities are offered to doctors in engineering.

Financial remuneration in industry is certainly not depending on having a doctoral degree or not, but since doctors get more opportunities and often move faster into the company's hierarchy, doctors in engineering most often receive better wages. Again, these results may be biased because doctors are pre-selected out of the best students.

6. DO YOU FEEL THAT THE DOCTORAL PROGRAMME WAS IMPORTANT FOR YOURSELF? DO YOU FEEL THAT YOU ARE A BETTER ENGINEER AFTER PHD RESEARCH? WOULD YOU REPEAT THE EXPERIENCE?

Here the answer is definitely «yes»: 94 to 100%!

According to the respondents, the doctoral research period «completes» the engineering education. One becomes a more «complete» engineer. It is a unique «once in a lifetime experience». Only once in a lifetime/career one gets the opportunity to take enough time to work intensely and purposeful and very targeted towards one single clear objective.

On the other hand, it has been said that the PhD «culture» is very different from the «industrial» culture. PhD research is very often a lonely, individual, introvert activity to obtain better «knowledge», whilst good functioning in an industrial environment requires teamwork, an extrovert attitude, contacts with many people and, above all, always keeping in mind the economic implications of cost and benefit rather that science and knowledge.

It is therefore not amazing that most of the content respondents report that they have been able to carry out their doctoral research in a well functioning team, which was part of a well performing and internationally active research group.

As «added values» of the doctoral programme mainly the experience gained and the acquired and improved skills and attitudes obtained are mentioned, very seldom «knowledge»:

- the stimulation of creativity
- perseverance: «a doctorate is a contest with yourself»
- a problem solving attitude
- the ability to formulate a problem and report about the results; experience with teaching: the challenge to clearly formulate and explain one's own knowledge to a critical audience

- the ability to «sell» results by publications, presentations, the doctoral thesis defence
- testing one's own ideas and views against an international panel or within the (international) research projects or conferences.
- learning to work hard (as if the regular engineering curricula are not already doing that!!)
- gaining self-confidence: "if you manage to finish off a doctoral research project, you can match any other challenge…".

The doctoral research period offers a unique opportunity for intellectual development. It is a splendid period of intellectual freedom. Most of the doctors in engineering would without hesitation repeat the experience (85%). In particular, the international contacts and contacts with other (foreign) researchers in the same field are highly appreciated.

Many respondents however feel that during the doctoral programme more attention should be paid to «industrial or business» aspects as there are: how can this device, process, programme or material be produced economically and commercialised? What would be its cost? How can the new ideas be applied in industrial practice?

Ideas should be tested against the reality outside the university.

One should be careful not to over specialise and therefore pay enough attention to other things outside the narrow research field.

7. DO YOU FEEL THAT THE CHOICE OF THE SUBJECT OF YOUR DOCTORAL RESEARCH WAS (OR IS) IMPORTANT?

The subject of the doctoral research and the specific specialised knowledge gained, are rarely reported to be of any importance (only 25% to 35 % answered «yes» to this question). What is felt to be important is the experience gained and certainly the acquired skills: the ability to work independently, to go in depth *to the bone* of a subject, to work in a systematic and fundamental, thorough way, to report properly and timely, perseverance …

Although the subject as such is not very important, it is important that it is (indirectly) relevant to industry. The research should ultimately lead to a product or a process applicable in industry.

Many respondents declare that the research group to which one belonged and within which the doctoral research was conducted is very important, much more than the subject itself. The research tradition and culture of the group, the presence of international research projects, an international and multidisciplinary team, the coaching by a (internationally) respected advisor and older doctoral students and post-doctoral researchers.

The fame of the research group reflects on the value of the doctoral work. You have to be «lucky» enough to become a member of a good research group.

8. CONCLUSIONS

Most engineering doctors have «ex post» a good feeling about their doctoral research period. They experienced a unique chance and opportunity for personal intellectual development and to «finalise» their engineering education. They have been able to work during an extensive period very intensely, independently and thoroughly towards a specific goal.

During the doctoral research period a number of skills and attitudes are acquired or improved, which yield profit when later starting to work in an industrial company. The very specialised knowledge obtained during the doctoral research is only rarely valorised later in industry. The research field however which has been chosen is relevant for the later career.

The value of a PhD work is not so much determined by its subject but by the research group where it has been carried out: the research culture, international contacts, name and fame of the group and the advisor… PhD research seems to be particularly valuable and rewarding if one has had the opportunity to work in the framework of an international (E.U.) project and in a multidisciplinary and international team. In such case PhD research is really a personally enriching experience and a warrant for the future.

The doctoral programme, strictu sensu should include a number of highly specialised courses in particular in the starting phase of the doctoral research, so as to get at the state of the art in the research field as fast as possible. Such courses can only be organised successfully and on a sufficiently high level if it is done in an international context. A good coaching within the research group by older doctoral students and post doctoral researchers may, to a certain extent, be a good substitute for these courses.

MASTER BUILDER TRAINING IN HUNGARY 2001 (RESTART OF THE EARLIER TRAINING)

Tibor Kukai[1]

ABSTRACT: *Base on an old-age tradition of the master builder title existing in Hungary, the reasons to restart their training are presented and discussed. They mainly emerge from the deep social-economical changes that have occurred in the country since 1989 and the subsequent great demand for a new generation of managers in the construction industry to satisfy the needs of market economy. The project began in 1999 with pilot-course programmes at two universities in Budapest and Pécs, with educators trained by one of Europe's best institution experienced in adult training. The participants in the two pilot courses graduated successfully in the autumn of 2000 and the spring of 2001. The programme is still carried on by constant signing up and there seems to be a steady demand for it from the side of the construction industry.*

1. INTRODUCTION

There is an old-age tradition of the master builder title in Hungary. The title could be gained between 1867 and 1945, together with all its rights. Master builders gained grave appreciation for themselves, and the title also. They worked in the field of building implementation , only mentioning a few great names, who also bore this title: Mihály Pollack, Imre Stendl, Miklós Ybl.

The act issued in 1990, which controls the right to building implementation, also included this title, claiming total implementation rights to its bearer above all. Although it could not be gained anywhere.

The following reasons are for the case of restarting this training:

- the building industry has been significantly restructured after the change of regime, competition has become its main characteristic;
- the best way of improving quality is through training;
- professional skills need refreshment periodically, and the best way of doing this is through organized professional training;
- the certification and theoretical confirmation of knowledge gained through experience increases security;
- an important element of the preparation for the expected joining to the European Union is the gaining of professional and market knowledge;
- in the area of building implementation there has not been any professional post-training.

Two years ago, with the support of the Higher Education Improvement Fund, the four building and construction technical colleges in Hungary have worked together on the restarting of master builder training. The working out of necessary notes and materials for the planned training have been in progress.

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The planned main subjects can be categorized in two groups:

- Professional subjects (construction technology, building materials, frameworks, building mechanics, building structures, building renovation, roof linings);
- Management subjects (construction marketing, business rights and ethics, construction organization, insurance, accounting, tax and financial studies, economicality of enterprises, guarantees of quality, human resource economy).

Chambers and professional organizations supported the thought of restarting.

It turned out, that trainings concerned with implementation have to be incorporated into a system. Post-trainings concerned with the field of implementation are not present, these need to be launched in co-ordination with the expectations of professional construction workers on different levels:

1. Engineer in charge training (post-secondary)
2. Building engineer training (construction manager) with the support of the Swiss Master Builder Organization (SBV), and ÉVOSZ (National Union of Hungarian Building Contractors)
3. Master builder training - (project manager)

(In the course of the paper I deal with the training itself, in detail.)

2. RESTART OF THE EARLIER TRAINING

Historic survey

There is an old-age tradition of bearing the title of master builder. It goes back to 1884, when after the ceasing of the former guild-system a new industry law was made.

This law has unambiguously determined the master builder, the master carpenter, and the stonecutter's implementation competence.

It was clearly determined what kind of professional readiness is necessary for the implementation rights of different buildings.

The meaning of the word master builder (taken from the original act) is: "The master builder (Baumeister, master builder) by its original meaning is a person with a master's degree - in the guild system taken as member of the guild - with the right to undertake implementation works; a *construction **master, a builder,*** who implements his/her own or other persons' building plans."

In today's interpretation: "A technical leader with personal responsibility, having the right to undertake building implementation."

It was epoch making at that time, even in European relations. This title - which was the highest qualification in building implementation-undertaking - could only be gained after receiving a diploma and by having a particular professional practice followed by a strict exam.

This law (with some modifications) was valid until 1949 (for 65 years), - during that time about 1900 people got the title of master builder in Budapest.

Master builders in the beginning have only undertaken the leading and doing of construction works, and some after roles of financial success have become building contractors.

Our building industry was among the first one in Europe at the end of the last and the beginning of this century when the following famous master builders marked its activity: Mihály Pollack, János Hild, József Hild, etc.

Budapest and some other cities have gained their present day appearance through the work of these master builders.

Some building contractors were more proud of their master builder titles than of their building contractors' diploma. Following the Second World War, until the process of nationalization, some of our master builders worked as contractors.

Then the title of master builders had been discontinued.

After nationalization some of them migrated to foreign lands, and those who stayed, having no other opportunities, became employees of those companies which were created out of their own ones.

Reorganization of the training

The social and economical changes in regime in 1989, and the public tenders made great demand for the new generation of managers in the building industry to satisfy the needs of the market economy. ÉVOSZ the National Union of Hungarian Building Contractors - which became aware of this necessity supported higher education's initiation to reorganize the training which has been present prior to the process of nationalization.

The most important notions which form the basis of the necessity to reorganize trainings:

1. The building industry has been significantly restructured after the change of regime, competition has become its main characteristic.
2. Personal responsibility has taken over collective responsibility both in the area of enterprise and the professional fields of constructions. This basically means different conditions, which we have to face.
3. Construction quality is below the expected level in all categories (expected lasting of frames, correct fitting of technologies, ethical questions, sizes, reliability, etc.)
4. The quality level of building implementation is guaranteed by the leader professionals, besides all other conditions, thus the best way of improving quality is through training.
5. The forming of personal conditions and way of thinking is one of the most difficult task, requiring plenty of time and effort, but it is also the most productive one.
6. Professional skills need refreshment periodically, and the best way of doing this is through organized professional training.
7. In the course of gradual training the available time is insufficient for giving students the experience needed for master builders, thus further training is required in the form of active experience.
8. The certification and theoretical confirmation of knowledge gained through experience increases security.
9. In the field of building planning the severity of regulations has been increased, but this was not followed similarly in the area of implementation (enterprise and professional responsibility are different).
10. Buildings these days are getting more complex, require more time, bar more improved technologies, utilize more delicate and more expensive materials, so compared to older ones the emphasis and reserves have changed, requiring a different approach. This development is accelerating, and it necessitates a different approach from those in the area.

11. In the course of renovation such complex tasks arise (building panels, monumental buildings, etc.) which require a complex approach and instant decision making in the course of work.
12. Complex tasks which require speed also require the co-ordination of subcontractors, whose work has to be organized, supervised, accepted and handed over to others by master builders achieving the satisfaction and further respect of customers.
13. An important element of the preparation for the expected joining to the European Union is the gaining of professional and market knowledge.
14. In the area of building implementation there has not been any professional post-training.

The first phase of the task having two tendencies took a turn towards the same direction. The first one was the two-year program/project won at the FEFA - Higher Education Improvement Fund- with the goal of preparing training reorganization, with the presence of ÉVOSZ, the Hungarian Chamber of Engineers, and the four technical colleges, Ybl Miklós Technical College in Budapest, Pollack Mihály Technical College in Pécs, and technical colleges in Győr and Debrecen.

Another program was also a two-year program/project with the same goal, which was carried out within the scope of co-operation of ÉVOSZ and SBV (Schweizerischer Baumeister Verband / Swiss Master Builder Organization). Both programs have been terminated successfully. The participants of the FEFA competition have worked out a syllabus for a four semester postgraduate training, which enables for receiving the second diploma, the master builder title. Notes associated with the training have been already named.

The participants of these two programs, the four technical colleges, ÉVOSZ and SBV, have later established an international syndicate, and relying on the preparational programs have worked out the final structure, syllabus and notes of the training.

For the preparation of the final structure of the training we analyzed the present day situation of the Hungarian building industry, and the future expectations in the end of the 90's.

In the European Union the production of the building industry makes 11-12% of the GNP of countries, while the same data in Hungary is around 6-7%. In this sense the assumption that in the course of economical stabilization the production of the building industry also has to reach the European average in market economy and competitive conditions, is correct. 90% of the performance of the Hungarian building industry is done by small and medium size enterprises, who employ 83% of those working in the construction industry.

Based on this data we can conclude that there is a great need for company managers, who have the competence, and bare modern knowledge.

The market analysis for training preparation is summarised in the Table 1.

Further analysis is needed on what building industrial characteristics for the joining of the European Union (or for the preparation to it) will require.

Table 1

Present situation	Future expectations
Restrained construction investment	National investment for the improvement of economy
The private sector in distrustful, there is no real demand	Enterprise- and investment friendly conditions need to be created
The number of persons working in the building industry has decreased to 1/3	Profile clearance, repression of illegal workers, effectiveness (number of employees is not increasing)
The areal distribution is concentrated - to "great Budapest" and western counties	Dynamic infrastructure improvement in eastern and north-eastern counties
96% of enterprises employs less than 20 persons	The ratio has to be changed - for those who really take the jobs ("phantom companies" have to be ceased)
Legal and economical regulations change at an extremely high speed	Consolidated legal environment
Execution is beyond control	The leading role of government offices and professional unions have to be put into effect
There is a lack of capital - interest charges are high, there is a lack of risk taking by banks	Consolidated capital market - real bank operation (financing)
There is no national industry and market protection	The economical competition office will do its work
Chambers have been established	Chambers will do their work
There are no skilled, only self-taught managers for new challenges	The development of competitive construction managers with up-to-date training

Before the determination of project goals, we concluded general facts of the analysis as follows.

The next years will bring meaningful changes in the building industry:

a) Markets will open introducing new products and making possible or necessary the application of new methods;
b) Qualitative increase will take over the place of quantitative increase;
c) New clients require complete solutions (expenses according to models, deadlines);
d) In the course of contractor training attention has to be turned on small and medium enterprises.

We collected the changes of building industry into the following theses:

1. The structure of construction services and construction enterprises is under change.
2. Competition is becoming tougher.
3. The human resource market requires greater flexibility.
4. The growing older of population and the level of unemployment is still increasing.
5. The importance of regulation and standardization increases.
6. The complexity of construction tasks increases.

7. New building materials / new manufacturing and installing techniques change the companies.
8. The presence of an effective plant-economical system of ways and means is indispensable.

From the expected changes and the theses of market analysis we have developed a professional path illustration, which master builders have to fulfil.

The master builder is also a *contractor*:

- He is responsible for the political, strategic and operative control of the whole enterprise, for which he has the qualification;
- He controls material purchase, production and sales in conformity with the market;
- He takes care of the success oriented positioning of the enterprise in the market;
- He understands the relations between market, competition, construction marketing, expense calculation and pricing;
- He works with regard to all his up-to-date knowledge about enterprise control, in all fields, utilizing modern work equipment;
- He urges his colleagues to effective group-work and assures constant post-training;
- As leader he bares the qualities of great work capacity and conflict tolerance, and trains himself according to this;
- He bares well established economical knowledge.

The master builder is also a *skilled professional*:

- He bares a wide range of construction technological knowledge.
- He utilizes his well established production technological knowledge and professional skills in environment friendly construction for the global solution of tasks (also in building renovation);
- He has the opportunity to observe other construction partners' (planners' and other construction executors') work, and is able to fulfill the co-ordination tasks in this area;
- He systematically strives for the fulfillment of increasing qualitative expectations;
- He takes care of integrating new materials and technologies in the construction process.

The master builder is also a *generalist*:

- He knows the methodology of optimal decision making;
- He forms the flow of information and transfer of communication in an optimal way, both within and outside the company;
- As a contractor and citizen, he gets involved in the circles of professional organizations and within these he strives for the freedom of contractors.

We have developed the strategies and main goals of the project according to the professional path illustration:

- The improvement of qualification of the decision makers in the Hungarian building industry (building professionals);
- The improvement of competitiveness of Hungarian building contractors within the Hungarian market;
- Training of competent trainers both professionally and methodologically;
- The qualitative improvement of training in technical colleges;
- Strengthening of professional organizations (ÉVOSZ, IPOSZ);
- Working out a higher quality master builder training with a final examination and a national diploma.

The realization of these trainings would be in Budapest - Pécs - Debrecen - and Győr cities.

The main beneficiaries of the project are the following groups:

on short and medium term:

- Building enterprises working with 20 to 50 employees, owners of small factories with the improvement of the quality of training of those colleagues who are in charge;
- The technical colleges of Budapest, Pécs, Debrecen and Győr, with the acceptation of material-modules and integration in education;

on long term:

- Hungarian authorities by having the opportunity of solving the legal controlling of contractor businesses through the re-introduction of master builders.

The work of those involved in the project has been controlled by a project patronage summarised in the Table 2.

Table 2

Switzerland	Hungary
EDA Federal Foreign Affairs Office	Ministry of Foreign Affairs Support-program Secretariat
BIGA	Ministry of Cultural Affairs
	Ministry of Labor
Federal Industrial, Enterprise and Labor Office	
Swiss Master Builder Organization Zürich Educational Center of the Swiss Master Builder Organization, Sursee	National Union of Building Contractors National Union of Industrialists
Project Counselors	
PROJECT BOARD of 10 persons from Switzerland and Hungary	
Project leading in the Educational Center of the Swiss Master Builder Organization	Project leading in Hungary

In the course of the realization of the project, as a first step, a selected group of educators (about 15 persons) from the four technical colleges have received a several months' training in Switzerland in the Swiss Master Builder Organization (SBV) on the special questions of adult training, and they have developed the syllabus and curriculum here in team-work.

The group of educators in the course of the Swiss training have acquired those didactic and methodological conceptions of adult training which have been developed through the decades by SBV and have been applied successfully.

These can be described as the following:

1. Creation of training concept

Preparation of teaching handbook

- Requirements
- Educational goals
- Educational scripts

2. Preparation of realization
Seminar announcement
- Educational goals
- Educational content
- Expectations
3. Realization
Teaching
- Goal oriented teaching
- Set for adults
- Different types of learners
- Participant activity
4. Evaluation
Realization
- Success analysis
- Feedback to educational centre

Through the methodological and didactic post-training SBV assured the following expectations:

- the selection and naming of materials to be taught in accordance with needs, educational goals and acceptability by learners
- the training should take place according to unique adult training and the educational goals in a group of a maximum of 24 persons, in the form of information pool
- there should be, separate of the trainer, a **TRAINING GUIDE**, which includes the following themes:
    - expectations from master builders
    - naming of educational goal
- books by subjects and necessary teaching materials

The main point of information pool adult training is that a group of a maximum of 8-10 students forms a work-group, who are seated around a circular table set up for this aim, where lead by the trainer they analyze the following subjects:

- Raising the subject
- Questions
- Educational discussion
- Educational aims, examples
- **DISPUTATION**
- Discussion of experiences
- Answers

Following the training of educators, a so called pilot course was started in 1998 according to the presented new master builder curriculum.

It is evident from this curriculum, that according to the needs and pre-schooling of the to-be-trained aim-group, the ratio of professional subject is 1/3, while the ratio of organizational, leading and economical subjects is 2/3 of the whole training.

Participants of the Hungarian post-gradual master builder training have finished their college or university studies, and need at least 3 years' of experience in a leading position. According to these requirements major differences arise between the education of college students and master builders.

While colleges and universities set out for a high quality of knowledge transfer (in semesters), the following check-up evaluation takes place, according to a questionnaire filled by both teachers and students:

Checking of teaching pack:

- are the theses still in effect?
- are the expectations still there?
- are the educational aims still suitable?
- do educational scripts match the goals set up?
- does the process of training follow the ARIVA model? (educating in an information pool form)
- do participants take part in the training actively?
- are they able to discuss their personal experiences?
- do we know their educational levels?
- do we activate all learner types?
- is the environment suitable?
- is the relationship between the trainer and students spontaneous, open and free?
- do the trained educators and students feel comfortable?

3. CONCLUSIONS

The restart of the master builder training prepared with a more than 1 million EURO expense, has started in 1999 with two pilot courses in Szent István University's Ybl Miklós Technical College Faculty in Budapest, and in the University of Pécs, in the Pollack Mihály Technical College Faculty, in Pécs.

As it can be observed from the paper, the training took place with educators trained by one of Europe's best institutions experienced in adult training. The training took place in the form of a nationally accredited higher level educational professional engineer training, with trainees of higher level engineer diplomas and at least 3 years of professional experience.

The participants of the two courses, in the autumn of 2000 and spring of 2001, have taken their national examination successfully, and they have received their professional engineer diplomas accordingly, with a German language, Swiss page insertion, with quality certification done by SBV.

The program is still carried on by constant signing up, there seems to be a great demand for it from the side of the building industry.

The governmental rule named the bearer of the master builder degree the person with the highest level of building industrial implementation rights. The students who have finished the pilot courses have set up the Hungarian Master Builder Organization.

PART FOUR

Accreditation and Professional Recognition in Civil Engineering

FACILITATING RECOGNITION AND MOBILITY IN EUROPEAN ENGINEERING EDUCATION

Giuliano Augusti[1]

ABSTRACT: *The creation of the "European Higher Education Space" strongly supported through the efforts of the European Commission and the "Declarations" of the Education Ministers, aims at an increased "harmonisation" of the educational structure, that has also received the support of the Academic world. Accordingly, appropriate procedures must be set up for "accreditation" and "quality assurance" so that engineering academic degrees and professional qualifications granted in a country can be easily recognised in other countries. The best way towards the final objective of an European "accreditation system" appears to be a bottom-up approach for mutual international recognition of engineering educational programmes and professional qualifications. The WG2 of the Thematic Network H3E has brought a large and significant contribution to facilitate this process. It must be accompanied by strict implementation of quality requirements in each country. The contacts and exchange of experience obtained through Thematic Networks (H3E, EUCEET, E4) and ESOPE can be of great help in this direction, and in developing international academic recognition and necessary synergy with accreditation.*

1. INTRODUCTION

A great variety of routes to the formation of engineers exists in Europe, different not only from country to country, but also within the same country. In the last few years, two phenomena in apparent contrast have been noted:

- on the one hand, an increased de-regulation and the increasing need of technical graduates of different specializations tends to increase the variety of the educational offer;
- on the other hand, the creation of the "European Higher Education Space", strongly supported by the political word through the efforts of the European Commission and the "Declarations" of the Education Ministers (Sorbonne, Bologna, Prague), press for an increased "harmonization" of the educational structure, that in the recent "Convention of European Higher Education Institutions" (Salamanca, March 2001) has received also the support of the Academic world (at least, the "official" Academic world).

To pursue this "harmonization" but to avoid turning it into a "cage", the means to follow are not strict and uniform rules for engineering educational programmes, but rather appropriate procedures for "accreditation" and "quality assurance", so that engineering academic degrees and professional qualifications granted in a State can be easily recognized in other states.

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Promoter of Activity A2 in Thematic Network "E4"

Indeed, the need for international recognition of educational programmes and professional qualifications increases in all fields as the job market becomes itself more and more international: this is all the more true for engineering, that is essentially international. On the contrary, not only no satisfactory system for such recognition exists in the European Region, but still, even in the European Union, more than ten years after the so-called General Directive 48/1989 aimed at assuring the "right of establishment" of all professional people in any Member State, the trans-national mobility of engineers (like of all other people) is still hampered by a number of obstacles, some real, but mostly due to insufficient knowledge and/or prejudices that we must try and overcome.

And if this is true within the European Union, the problem becomes even greater when we consider the whole of Europe, including Eastern States - be them candidate members of EU or not - and other neighbouring States.

The way and means to pursue this objective have been dealt with by Working Group 2 "Quality and Recognition in HEE" of the European Thematic Network "Higher Engineering Education for Europe" (H3E; 1997-99), and are now the object of an analogous group (Activity 2: *Quality assessment and transparency for enhanced mobility and Trans-European recognition*) within the new Thematic Network "Enhancing Engineering Education in Europe" (E4; 2000-03). Much of what I shall say in the following has been (or is being) elaborated within these Networks: a diagrammatic summary of the present status of our work is shown in Appendix A.

2. SOME DEFINITIONS

Before going on, it is appropriate to define the use of some terms, and in particular of *recognition* and *accreditation*, two rather vague terms which according to dictionaries are almost synonyms.

The European Commission, in a "Communication" of December 1994[2], defined four types of "*recognition*" for professional and academic purposes, namely:

1. *De jure professional recognition*
2. *De facto professional recognition*
3. *Cumulative academic recognition*
4. *Academic recognition by substitution.*

In the "Lisbon Convention"[3], *recognition* is defined as "A formal acknowledgement by a competent authority of a foreign educational qualification with a view to access to educational and/or employment activities"; in turn, a "*qualification*" can be either a *Qualification giving access to higher education*, or a *Higher Education Qualification*, defined as "Any degree, diploma or other certificate issued by a competent authority attesting the successful completion of a higher education programme".

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2 Communication on recognition of qualifications for academic and professional purposes, presented by the European Commission to the Council and the European Parliament, December 1994. See also "Synergies between academic recognition and professional recognition", results of the organised debate, Report produced by EC-DG XXII in collaboration with EC-DG XV, April 1996.

3 "Convention on the Recognition of Qualifications concerning Higher Education in the European Region", approved in Lisbon in April 1997 by the Council of Europe and the UNESCO European Region, and now in the process of being adopted by many States,

On the contrary, up to very recently, the term “*accreditation*” has never been defined or used by the European Commission, the Council of Europe, or any other “official” European body. The quoted Lisbon Convention defines “*assessment*” (either *of Institutions or programmes*, or *of individual qualifications*) but not “*accreditation*”. Nevertheless, the latter term has become rather widespread because of its use in the USA, where the ABET (Accreditation Board for Engineering and Technology) is active since the ‘30s: ABET defines its *accreditation process* as a system which “assures that graduates of an accredited programme are prepared adequately to enter and continue the practice of engineering”.

In this lecture, as in all wg2 documents, *recognition* and *accreditation* will be used with the following meanings (but will nevertheless be often difficult to distinguish from each other).

Recognition, without adjectives, is identified with “Academic Recognition” (i.e. the recognition given by a University, another Institute of Higher Education, or a National Educational Authority to degrees and qualifications awarded by another Institution or in another country).

Accreditation in a general sense can be defined as a procedure by which “credibility” is given by an external body to a programme, a degree or an educational institution in order to support or ensure recognition by a third party. By this procedure the accredited programme (or the Institution offering it) is “certified” as possessing a certain standardised or generally satisfying quality with regard to a specific purpose. More specifically - in accord with the American usage - *accreditation* is identified with the acceptance of a specific degree or educational programme as giving the graduate sufficient preparation to start or continue on a career as a professional engineer.

According to this definition, what can be “accredited” is an “educational programme” (not an “individual”), and the accreditation process always "belongs" entirely to the accrediting body (for instance, the accrediting body is the Engineering Council in the UK, the ABET in the USA). The criteria of assessment may be set entirely by the accrediting body (and accepted by the concerned parties) or by a National Law or an European Directive (e.g. the Architects' Directive).[4]

The holder of an “accredited degree”, possibly after fulfilling some further non-academic requirements (and often some bureaucracy), is entitled to what is best defined as “*professional qualification*”, i.e. the right (*de jure* or *de facto*) of actually practising his/her profession. In many countries, this coincides with the acceptance of the engineer in a “Guild” (Order, Association, etc.). However, the recognition of the professional qualification can be much less formal: in fact, even in countries where Orders and/or well established professional Institutions exist, many enterprises do not require their membership before hiring an engineer.

It is therefore all the more essential that a presumption of credibility also exists between the addressees of the accreditation, e.g. the enterprises, and the accrediting body. Otherwise, the enterprises, and also the engineer’s clients, have nothing on which to base their trust in the engineer’s education. In any case, let us keep well distinct

[4] It is however to be noted that, while the previous definition stresses the presence of an external accreditator, in the already quoted Salamanca “Convention of European Higher Education Institutions”, “accreditation” has been used in the meaning of “quality certification”, i.e. as a moment of the quality assessment and quality assurance procedures internal to the Educational systems. To avoid confusion, “accreditation” in the previously defined meaning should perhaps be referred to as “external accreditation” or professional accreditation”.

"professional qualification" (of an individual) and "accreditation" (of an programme, or also of an educational Institution, but only in the sense that it offers one or more accredited programmes of study).

Let me also remember that international recognition of "professional qualifications" cannot and must not be identified with "equivalence of degrees", but rather with "equivalence of professional qualifications": therefore its requirements cannot be related only to academic education, although cannot ignore it, because it does form the basis of the engineer's culture.

Finally, it is very important to underline that accreditation is useless, if not counterproductive, if based only on formal requirements and not strictly connected with a process of quality assessment and quality assurance. A consensus on the parameters for quality assessment in education (and all the more so in engineering formation) has not yet been fully reached (H3e-wg2 has approved a "Position Paper" on this problem): nevertheless, the development of accreditation cannot wait.

3. ACCREDITATION AND RECOGNITION AT PRESENT IN EUROPE

I have already stated that in my view *"accreditation*" has a meaning and a purpose only if it helps to achieve international recognition of the professional qualification of engineers.

Clear, transparent and flexible accreditation procedures are necessary for this purpose: however, no truly European system of recognition and accreditation of engineering degrees and professional qualification of engineers exist at present.

This lack is due, among other things, to the great differences existing between the national systems of the EU Member States, from both viewpoints of the educational system, and of how the engineering profession is organised. For instance, where engineering titles and profession are not regulated or protected by law (and this is the case of most European countries) recognition and/or accreditation can be only *de facto*; on the contrary, *de jure* recognition is essential in the countries in which the law regulates the profession.

Allow me to underline that such profound differences within Europe, and the consequent differences in the engineers' formation and profession, are not occasional but derive from the fact that Europe is a Continent of *many cultures*. And I do not think that the different cultures could or should be forced to *melt* into the pot of single model, but rather that exchanges and increase of mutual knowledge should be facilitated, so to set the ground for trusting each other more and more, and solving our problems together. I strongly maintain that this is the correct way to help the development of a truly united Europe, and also to make Europe able to play a role towards other countries, in particular the surrounding countries.

I shall not repeat here the description of the procedures and systems of engineering accreditation and recognition in the European countries, that I have already repeatedly presented elsewhere[5]; anybody interested may consult the "State of the Art" Report of wg2, and in particular Chapter 3: this will be continuously updated into a

[5]See e.g. G.Augusti: Enhancing Trans-National Recognition of Engineers: compatibility or convergence of formations? Keynote Lecture at SEFI Annual Conference, Paris, September 2000

"standing document" of E4 Activity 2 that will take care of the significant changes now in progress [cf. Appendix A].

From such descriptions, it appears that procedures for recognition and accreditation are well established, even if sometimes not formalized, within most European State, and are being introduced in others. On the contrary, very little exists on a trans-national level besides the systems for professional qualification set up by the two main European Associations of Professional Engineers, FEANI and CLAIU.

FEANI gives the right to use the title of "EurIng" to individual applicants who fulfil a certain formula which takes into account academic education in an accredited Institution, training and professional experience; as long as an applicant fulfils the quoted formula, no distinction is made between "long-cycle" and "short-cycle" graduates. There are also provisions for "exceptional cases", that must each be approved by a specific individual process. The list of accredited Institutions and degree programmes is published and kept up-to-date by FEANI: new Institutions and degrees can be included only after a visit by an ad-hoc Committee.

The CLAIU approach is similar, but is based directly on mutual trust between its Member Associations: each member of a CLAIU-Member Professional Association has the right to be considered and treated as a member of all other Associations. Also CLAIU publishes a list of accredited Educational
Institutions: it coincides with the sum of the lists of the Institution accredited by the single Member Associations.

Although the FEANI and the CLAIU schemes might be seen as the embryos of an European Accreditation system, they cannot be considered fully satisfactory. If anything, they are limited to the "minimal" requirements for the practice of the engineering profession and do not distinguish between engineers, neither "vertically" (i.e. between "short-cycle" and "long-cycle" graduates, who often correspond to different professional roles) nor "horizontally" (i.e. between the different engineering branches, a distinction that ABET is formally introducing).

All other current multilateral *international accreditation* initiatives that I have heard of are not "European", but essentially regard English-speaking countries, beyond the frontiers of the EU. They are clearly inspired by the British approach, that keeps clearly separate *"accreditation of educational programmes"* from *"professional licence"*, and facilitated by similar educational systems, consistent with this approach. Probably, the most important of these initiatives is the Washington Accord for the automatic accreditation of Engineering programmes: signatories of this Accord, renewed in 1997, are the National Organisations of Great Britain, Ireland, Australia, Canada, New Zealand, South Africa, Hong Kong, USA (ABET).

However, examples of recognition agreements within systems with different approach also exist: a very interesting and promising example is the French-Canadian mutual recognition agreement.

4. PERSPECTIVES FOR THE FUTURE

While, as already repeatedly stated, accreditation procedures are essential for the aim of trans-national recognition and mobility of engineers, to suggest any form of overall European Accreditation System, is unrealistic, at least for the time being.

The best way towards the final objective of an European "accreditation system" appears therefore a bottom-up approach for mutual international recognition of engineering educational programmes and professional qualifications. In other words, the system should be established not through the establishment of a single European "accreditation body", but rather by promoting and facilitating increasing contacts and agreements between National bodies, and thus building up gradually a consensus, perhaps starting with mutual recognition of accreditation bodies, and agreements between countries of similar systems and cultural background. In the end, the system might look more like an European "Washington Accord" than an "European ABET".

H3E-wg2 has worked hard in order to facilitate this process. In December 1998 we convened in The Hague the first "*European Workshop on Accreditation of Engineering Programmes* EWAEP", inviting not only the Academics members of H3E, but also governmental, para-governmental and other bodies dealing with quality assurance and accreditation of Engineering programmes, like the French "Commission des Titres d' Ingenieur" and the British "Engineering Council".

EWAEP started a series that already counts three Workshops [listed in Appendix A]. In particular, EWAEPs have clearly indicated that times are not mature to pursue the formation of a unique supra-national structure or procedure for accreditation of engineering programmes; rather, a consensus on European-wide procedures for recognition and accreditation should be built gradually through "bottom-up" agreements between the responsible bodies, with full-hearted participation of both the Academic and the Professional worlds. This idea lead in September 2000, as a further step in the process, to the establishment of the "European Standing Observatory for the Engineering Education and Profession" (ESOEPE), "*intended to build confidence in systems of accreditation of engineering degree programmes within Europe"* and not *"to harmonise engineering programmes nor accreditation procedures, but simply to assist national agencies and other bodies in planning and developing such systems"* and to *"facilitate systematic exchange of know-how in accreditation and permanent monitoring of the educational requirements in engineering formation"* [some facts about ESOEPE are summarized in Appendix B].

5. HOW TO "ACCREDIT" AN ENGINEERING PROGRAMME: WHAT SHOULD BE REQUIRED?

After discussing for three years all these problems, we in H3E-wg2 became convinced that the stress in the requirements for accrediting a programme must be shifted from the way in which the programme is constructed and run (which leads to prescriptions on the curriculum) to requirements on its "final product", i.e. on the "competencies" acquired by its graduates: this shift will also allow the great diversity of educational systems throughout Europe to be an asset for, and not an obstacle to, recognition (the Americans call this type of evaluation "outcome assessment").

The maximum *transparency* of course objectives and contents is a prerequisite to pursue this objective: each educational institution must provide complete information about itself. In other words, it is required to make more and more visible which type of qualification profile is produced by each engineering education programme. Each engineering education provider will have to demonstrate which qualification profiles of engineers they have defined and which they produce. Indeed, this will be in accord with the Lisbon Convention, which in its Article III.4 says *"Each party shall ensure, in* *order to facilitate the recognition of qualifications, that adequate and clear information on its education system is provided".* But, because of the repeatedly noted - and increasing - great diversity throughout Europe, this information must comprise detailed information on competences and cannot remain general, by just nominating a type of school that trains engineers or a degree that is awarded.

Both academic as well as professional recognition will profit from such an increased transparency. This is especially true if the transparency does not only cover structures and input data but concentrates on outcomes of the various types of engineering education and on qualification profiles achieved through initial and continuing education and professional experience.

How to make this information available and easily understandable is a problem in itself: a "common language" is needed to describe educational outcomes or qualification profiles in engineering. It could be a basis also for the various internal or external assessments employed to ensure adequate recognition as well as quality maintenance and improvement.

In my view, an essential point of the system to be created must be its capacity to give the proper recognition to each "type" and "branch" of engineer, with the appropriate differences: this requirement is not satisfied by most existing National systems nor by the "Register" of FEANI (nor by the CLAIU system), that set only minimum standards.

To this aim, E4 should carry forward wg2's suggestion to elaborate differentiated lists of "qualification attributes" with regard to engineering education and professional practice, including a categorisation of "types" and specialisations in relations to the degree at which certain attributes must be achieved. These lists should be based on descriptions of aims and objectives of the various programmes and profiles of engineering education, performance records like the "European Record of Professional Achievement in Engineering"[6], the European Diploma Supplement (suggested by the Lisbon Convention and currently being implemented, but without differences in the several Academic subjects), outcome-oriented criteria and standards of accreditation procedures and competence-oriented assessment approaches. These developments should finally lead to a *two-dimensional grid* of Engineering Qualifications, taking into account, in an equilibrated way, both academic (and non-academic) *education* (possibly, including *continuing education*) and professional *experience and training*. The columns of the grid should correspond to different "*levels*" (or better, "*types*") of qualifications, and lines to the different *branches* of engineering; existing and "planned" courses should be included.

Possibly, the proposed grid should be enhanced - in a kind of pilot benchmarking - by examples or explanations how the respective attributes can be achieved, even if the decisions about the qualification profile, which a certain programme aims at, and the ways to get there are issues of concern and responsibility of the respective department or higher education institution. Also, the problem whether an intended outcome really has been achieved, in other words the ways of an appropriate outcome assessment, must be tackled.

[6] EuroRecord: The European Professional Record of Achievement in the Engineering Industry; developed by the University of Cambridge Programme for Industry within the "Leonardo da Vinci" Programme of the European Union (A summary can be found in: C.Padfield & A.Hagström: Professional Record of Achievement in Engineering: towards Portable Qualifications, Proceedings 7th World Conference on Continuing Engineering. Education, Turin, May 1998)

I think this will be a hard but rewarding task, and I hope the friends from EUCEET will be willing to collaborate with us with regard to the Civil and Environmental Engineering branches.

6. CONCLUDING REMARKS

Summing up, the need for international recognition of engineers' qualifications appears evident. In the long range, an European "*accreditation system*" must be created, and it is essential that it be based on mutual trust.

The way to approach this final objective, however, does not appear to be the establishment of a single European "*accreditation body*", but rather to promote and facilitate increasing contacts and agreements between National bodies, and thus build up gradually a consensus, perhaps starting with mutual *recognition of accreditation bodies*, and agreements between countries of similar systems and cultural background. In the end, as I have already said, the system might look more like an European "*Washington Accord*" than an "*European ABET*".

The development of lists of "Qualification Attributes" to measure the competencies of each "type" of engineer, and the existence of "Quality Assurance" procedures can make the issue of trans-European recognition of courses and degrees, also for professional purposes, much simpler to tackle: widespread and frequent contacts, like those allowed by ESOEPE, may provide a path to a smooth form of "accreditation" through mutual trust.

Of course, the whole process must be accompanied by strict implementation of quality requirements. In many European countries this is ensured by a Quality Assurance procedure, suggested to HEE institutions in order to validate the learning opportunities they offer; and supported by a Quality Assessment body, managed either by the competent Ministry or by professional associations or both. It is hoped that more and more countries will develop such systems: the contacts and exchanges of experiences obtained through Thematic Networks (H3E, EUCEET, E4) and ESOEPE can also be of great help in this direction, and in the development of international academic *recognition* and the necessary synergy with *accreditation*.

In the meantime, any means to promote the exchange of experiences is welcome: this is the purpose of the series of papers being published by the European Journal of Engineering Education: the papers published up to the time of writing are listed in Appendix C. I do hope to be soon able to add a long awaited paper from Prof. Manoliu, plus some results of this Conference.

APPENDIX A

Thematic Network H3E Higher Engineering Education for Europe

Working Group 2: ***Quality and Recognition in HEE***

(operative: January 1997-July 1999)

Follow-up:

Thematic Network E4 Enhancing Engineering Education in Europe

Activity 2:

Quality assessment and transparency for enhanced mobility and trans-European recognition

(kick-off meeting: March 2001)

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Documents produced by H3E-wg2 and their present status:

- State-of-the-Art Report "Quality and Recognition in Engineering Education", Chap.1: Review of EU engineering educational systems

  Will become a document of E4 Activity 1
- State-of-the-Art Report "Quality and Recognition in Engineering Education", Chap.2: Quality Assurance and Quality Assurance *(Rapporteur: Muzio Gola, Torino)*
- State-of-the-Art Report "Quality and Recognition in Engineering Education", Chap.3: Accreditation and Recognition *(Rapporteur: Giuliano Augusti, Roma)*

Are being up-dated and extended to other European countries, as documents of E4 Activity 2

wg2 Position Papers:

Quality and Quality Assurance: A proposal for a formalised procedure for achieving good quality teaching of engineering in European universities

(Rapporteur: John Sparkes, Hemel Hempstead)

Recognition and Accreditation of Higher Engineering Education in Europe

(Rapporteur: Günter Heitmann, Berlin)

in print on the European Journal of Engineering Education

- **EWAEPs: European Workshops on Accreditation of Engineering Programmes**

1: The Hague, 3-5 December 1998 (promoted by H3E-wg2)
2: Paris, 17-19 June 1999 (promoted by H3E-wg2 and CTI)
3: Darmstadt, 26 January 2001 (promoted by the European Standing

Observatory for the Engineering Profession and Education ESOEPE, established in Paris on 9 September 2000)

wg2 final documents will soon be available on the web, together with E4 material, at the address:
www.ing.unifi.it/tne4

APPENDIX B

European Standing Observatory for the
Engineering Profession and Education (ESOEPE)
Excerpts from the Agreement, signed in Paris on 9 September 2000

Preamble

In a discipline which must change constantly to satisfy the demands of our technology-based society, the diversity of engineering degree programmes within Europe is a source of great strength. Nevertheless, as professional engineers become more mobile, society seeks greater assurance of the quality and relevance of provision of engineering programmes: hence, some form of "accreditation" becomes a must.

This agreement is intended to build confidence in systems of accreditation of engineering degree programmes within Europe. It is not intended to harmonise engineering programmes nor accreditation procedures, but simply to assist national agencies and other bodies in planning and developing such systems. It would also facilitate systematic exchange of know-how in accreditation and permanent monitoring of the educational requirements in engineering formation.

Purposes

- facilitate the free exchange of information and provide an effective communication channel;
- provide such information as already exists within each country on topics and issues connected with educational and professional engineering standards;
- encourage participation … in as many European countries as possible …, and facilitate throughout Europe the development of good practices of Endorsement/ Validation/ Accreditation and the establishment of Agencies for that purpose;
- facilitate voluntary agreements on accreditation of engineering educational programmes and recognition of engineering qualifications;
- facilitate the development of standards on the competence requirements of graduate engineers.

Initial Signatories of the Agreement (Founding members of ESOEPE)

- Engineering Council (UK) [A.Ramsay]
- Commission des Titres d' Ingenieurs (FR) [F.Tailly]
- Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften und der Informatik ASII (DE) [K.Hernaut]
- Ordem dos Engenhieros (PT) [J.M. Ferreira Lemos]
- Collegio dei Presidi delle Facoltà di Ingegneria (IT), promoter of "Sistema Nazionale di Accreditamento in Ingegneria" SINAI [A.Squarzoni]
- Thematic Network "Enhancing European Engineering Education" E4 (EU) [C.Borri]

New members of ESOEPE include FEANI, SEFI, the Union of Associations of Civil Engineers of Romania, the (Romanian) National Council of Academic Assessment and Accreditation.
An ESOEPE page will soon be established on the FEANI website
http://www.feani.org

APPENDIX C

European Journal of Engineering Education
(Official Journal of SEFI – European Society for Engineering Education)

Editor-in-chief: Jean Michel, ENPC, Paris

Papers on **Trans-national Recognition and Accreditation of Engineering Programmes**

Guest Editor: Giuliano Augusti, Università "La Sapienza", Roma

Papers published or in print (as of July 2001)

Vol. 24, No.1 (March 1999):
- G.Augusti: European Engineering Formation: the problem of trans-national recognition

Vol.24, No.2 (June 1999)
- L. Schachterle (USA): Outcomes assessment and accreditation in US Engineering formation
- D.A. Nethercot (GB): Professional accreditation in the construction sector: the role of the UK's JBM

Vol.25, No.1 (March 2000)
- G. Brusselmans (BE): "Accreditation" of Engineering studies: formal systems vs. individual responsibility
- D. Jeffries, J. Evett (GB): Approaches to the international recognition of professional qualifications in Engineering and the Sciences

Vol.25, No.3 (September 2000)
- J. Alvarez del Castillo (ES): Evaluation and accreditation of Engineering Programmes in Latin America

Vol.26, No.2, June 2001
- Surek Bordia (PNG): Problems of accreditation and quality assurance of Engineering Education in developing countries.
- Antonio Salgado De Barros (PT): Engineering courses and accreditation in Portugal

In print (Vol.26, No.3, September 2001)
- I.Akduman, L.Ozkale, E.Ekinci (TR): Accreditation in Turkish Universities.
- B.Macukow, M.Witkowski (PL): Non-University sector of higher education closer to the labour market: the Polish experience.
- Itsuo Ohnaka (JP): Introduction of Accreditation System in Japan.

- Wendy Ryan-Bacon, Gilles Y. Delisle (CA): Recognition of substantial equivalence of engineering competence: the Canada-France mutual recognition agreement.
- H3E-wg2 (G.Heitmann, G.Augusti): Recognition and Accreditation of Higher Engineering Education in Europe: a position paper.

Forthcoming

- Barbara M.-L. Steiger: Introduction of Accreditation in Germany

WTO GATS REGISTRATION AND MUTUAL RECOGNITION OF ENGINEERS

John Whitwell[1]

***ABSTRACT**: At the beginning of the 21st century there is evidence that people live more and more in a "global village". In the spirit of working closer together people need to be able to implicitly rely on each other and trust the services each other provides. It is gaining this trust in each others' standards in civil engineering that has led to the signing of the Washington Accord and eventually influenced many other alliances. A lot of work has been already done to harmonise engineering standards in general and standards of competence in particular for the better serving of society. The higher skills needed by tomorrow's engineers are in a wider range than ever before; there is a need for specialists in a lot of particular disciplines, as well as for generalists having wider interdisciplinary skills. Among the leading expert groups acting on the way towards global harmonization, one should mention those working within the framework of the Washington Accord, EU Directives, WTO and its GATS 2000 initiative, the Engineers' Mobility Forum and APEC. A Working Group has been set up by ECCE to examine how an European qualification system could be established to parallel EMF or APEC, in order to guarantee to all European civil engineers that their qualification will be recognized everywhere in the near future.*

1. INTRODUCTION

Now we are in the twenty first century, the evidence that we are indeed living in a global village becomes everyday clearer. We communicate in seconds between one end of the earth and another. We travel to the ends of the earth in hours rather than months and years. We think nothing of buying goods from the other side of the world. Multi-nationals sell identical products in every major centre of civilisation from Moscow to Montreal and St.Petersburg to St.Louis. We turn on the television and have an armchair view of a game of football being played live 10,000 kilometers away. Our air traffic controllers, airline pilots and engineers communicate in the linqua franca English and politicians spend vast amounts of time and financial resources in extending alliances welding us inextricably together.

There can therefore be no doubt that in the spirit of working closer together we need to be able to implicitly rely on each other and trust the services each other provides. Whilst therefore, people can generally be understood by speaking "English", we also need to understand and know that the engineer we are working with has the same standards, recognises similar specifications, the same formulae and given similar problems will come up with similar answers without wasting our time.

This does not just affect those of us who travel around the world selling engineering expertise. It is just as important for those organisations who are internationally networked. Those organisations who are at the end of a working day in

[1] CEng FICE, Director International ICE & Secretary General ECCE

Bangalore, India down load an engineering problem to Birmingham who in turn down load it to Baltimore. Without trust in each others standards, the scenario of the vast global engineering village just would not work and it is gaining this trust in each others' standards in civil engineering that has led to the signing of the Washington Accord and influenced many other alliances like EMF, APEC and ECCE which I shall outline in this paper.

The realisation that we needed to start working together has been with us for some time. We have already done a lot of work to harmonise engineering standards and the whole ethos of the Professional Engineering Institutions is pervaded by the need to achieve well understood standards of competence for the better serving of society.

It is now widely accepted that the qualification of a professional engineer has four components

- An academic test (a period in University or College)
- A period of structured professional experience
- A test of professional competence and award of a recognised qualification
- Continuing Professional Development

For the majority of engineers the current route to achieve the academic test is now via 4 or 5 years full time study at University.

The second component of qualification – structured professional training – takes place in the workplace, under the supervision of competent professional engineers. This normally takes a minimum of 4 years, but can be longer and enables the theory learnt in University to be put into practice. An engineer during this phase will be solving problems all the time to gain experience. A period of experience in lieu of training is an alternative.

The third component, the test of professional competence, is undertaken through the Professional Institution. A successful candidate then achieves the status of a Chartered Engineer – a recognised professional engineer capable of solving complex problems.

The result is a qualification that is designed to fit tomorrow's engineer for the ever increasing demands placed upon them by modern business. The existing system has for many years produced some of the world's finest engineers, but there is an increasing demand for wider skills than those previously taught in the core curricula. And there is a need for greater diversity. Engineering in the built environment requires a higher standard of technical and organisational skills than ever before, and this trend will certainly continue. Clients and customers of construction rightly demand higher standards, and at the same time greater value and economy. This is not surprising. We live in a fast changing world where for business to succeed people need to be able to communicate easily, to share ideas, to provide services and to move goods economically. And, of course, society at large is increasingly concerned about the quality of the environment created for them to live and work within.

The higher skills needed by tomorrow's engineers are in a wider range of skills than ever before. This creates a tension in the education and training process. There is a tension to resolve between the need for specialists in particular disciplines, and generalists who have wider interdisciplinary skills, and the ability to design and manage the whole process.

For example, large modern construction projects can use engineers skilled in:

- Geotechnics
- Materials science

- Dynamic analysis
- Wind engineering
- Fire engineering
- Curtain wall design
- Sound and vibration
- Project planning and management
- Safety and risk
- Electrical systems
- Mechanics
- Building services

In addition to these specialist skills, we increasingly need engineers with broader skills. Engineers who have a broad understanding of other disciplines, and the ability to draw together the specialist skills needed to add value and reduce cost. These include an understanding of human relationships, motivation and the 'art' of engineering.

So where are the movers and shakers who are going to lead and enable us engineers to be well prepared for the bigger and bigger challenges of the new millennium as the world population goes up by a billion every ten years or so.

Within the many people working in engineering the specialists, the educationalists and trainers began to set up expert groups such as the Washington Accord.

Let me give you some insight into some of these groups who are leading the way to global harmonisation today.

2. THE WASHINGTON ACCORD

In the late 1980s Accreditation authorities in the UK and America realised there would be benefits in harmonisation of standards and process in academia.

If standards in one country were accepted by another then mobility of engineers could be made easier and qualifications recognised more quickly.

Eventually six countries UK, USA, Canada, Australia, New Zealand and Ireland got together and signed what is now known as the Washington Accord.

Subsequently Hong Kong, South Africa and Japan have joined and a number of countries have gained observer status.

Accreditation systems within the Washington Accord are not identical. We do not accredit in the UK to precisely the same process as Canada and the USA does not process applications in exactly the same way as Hong Kong. What we are however happy about is that the courses accredited create a graduate engineer with equivalent standards and that graduates from the universities of one country will be recognised and can perform competently within another country's jurisdiction.

The System of accreditation under the Washington Accord has been used in individual institutions' accreditation in Singapore, Bangladesh, West Indies, Ghana, India, China and the Russian Federation.

Professional institution membership or registration and licensing demands an accredited academic qualification at Washington Accord level. Hence the strong control of accreditation exercised by the Professional Institutions in many countries.

The value of accreditation is as a quality control tool. The accredited course is certified as having met an agreed threshold. Courses are in many cases of a higher standard than the threshold. Accreditation has not developed a categorised or league table approach.

Once a system of accreditation for the academic phase was working it was inevitable that there would be moves to harmonise full professional qualifications to aid engineering mobility even further.

3. EUROPEAN DIRECTIVES

The European Union first started thinking about mobility of professionals in the 1970s and 17 years later by 1989 a directive EEC/89/48 was agreed under which professionals would be recognised in all countries of the Union.

Inevitably it is not as simple as that and you still have to prove your competence but we are progressing.

4. WORLD TRADE ORGANISATION

All of this harmonisation of qualifications is taking place under the influence of the World Trade Organisation (WTO) and their General Agreement on Trade in Services (GATS 2000) initiative. This initiative basically sets a date of 2002 for opening borders to professional mobility in order that engineers of a recognised standard should be able to move and be recognised as competent through the world.

The reality is that the best engineers want mobility, recognising that their careers will only develop from new experiences and movement to where the work exists. As a result the countries that are going to succeed in the future are those who welcome mobility and refuse to accept isolation. Countries that resist globalisation will sink because they will not be able to keep up with the vast rate of change without welcoming foreign professionals in and encouraging their own professionals to work elsewhere. The reality also is that for us to cope with the challenges of the millennium we need to encourage engineers to move and to do this we need to give them qualifications that will be recognised wherever they go.

The encouraging thing about the WTO and GATS 2000 is that the way it works is up to us as engineers to decide. GATS 2000 says we need a system and you the professionals should agree what it is. We as engineers are now deciding through EMF what system of qualifications we want in order to implement the system worldwide. We are actioning this by the following initiatives.

5. THE ENGINEERS' MOBILITY FORUM AND ASIA PACIFIC ECONOMIC COMMUNITY

At the same time as harmonisation of accreditation has been occurring under Washington Accord various other alliances have been harmonising fully professional qualifications for engineers. Notable amongst these groups are the Engineers Mobility Forum formed by the Washington Accord members and the Asia Pacific Economic Community Engineer organisation covering countries around the Pacific Rim. Both of these groups have applied to the WTO for recognition of their standard.

An approved GATS system needs to establish a qualification that:

- is based on procedures that remove the barriers to mobility in a non-discriminatory manner between its members.
- is seen by national governments as fair and reasonable and attracts their support.
- is workable, can be managed and covers technical and professional competence to analyse, solve and implement complex problems.
- has a quality assurance procedure, total transparency and operates to a code of professional conduct and ethics.

Both EMF and APEC work to the same standard and their processes are now being tested. In order to produce a system that will be universally acceptable the period of post graduate training and experience has been extended to seven years with at least two years in a position of responsibility. This has enabled the USA to sign but it does not offer a "right to practice" in countries where this may be regulated by others such as in the US. Hopefully, the wide agreement on a world standard will ultimately be seen as adequate for all regulatory bodies.

ECCE has established a Working Group to examine how a European qualification could be established to parallel EMF or APEC. These discussions are being attended by 11 of the 22 members of ECCE and there are encouraging signs that a qualification will be developed thus enlarging the International Group to 30-40 countries. This, coupled with the tripartite agreement between UK, Italy and France, will hopefully give greater guarantees to all European engineers that their qualifications will, in future, be recognized everywhere without let or hindrance.

ACADEMIC ASSESSMENT AND ACCREDITATION SYSTEM IN ROMANIAN ENGINEERING EDUCATION

Iacint Manoliu[1]

ABSTRACT: *Since 1993 a Law on accreditation of higher education institutions and recognition of diploma was enforced in Romania, leading to the establishment of a legal basis for a system of accreditation and quality assurance of higher education institutions. The paper describes the system and the main results obtained since its implementation.*

1. INTRODUCTION

Before the December 1989 Revolution, all higher education institutions in Romania were public institutions, under the authority of the Minister of Education. There was no need for accreditation. The situation changed suddenly in the spring of 1990 when, taking advantage of some holes in the legislation, first private university announced with a well orchestrated advertising campaign its apparition on the educational market. The timing was well chosen with the entrance examination approaching and the number of potential candidates exceeding several times the number of places offered by the public universities. The result was a true "explosion" of the private sector in higher education. At the same time, changes occurred in the public sector, too, with the transformation of a number of institutions in universities, with the creation of new faculties and development of new degree programmes.

To better assess the magnitude of the phenomenon, the figures in the table 1 are provided.

Table 1

Academic year	1988/1989	1993/1994
Number of public universities	44	56
Number of faculties in the public universities	101	237
Number of private universities	-	74
Number of faculties in the private universities	-	396
Number of students in the public universities	164.507	240.000
Number of students in the private universities	-	100.000

The distribution of students among various fields, for each of the two sectors, in the academic year 1993-1994, is shown in the table 2.

[1] Professor, Technical University of Civil Engineering of Bucharest

Table 2

Study area	Percentage of students	
	Public universities	Private universities
Engineering	37	1,5
Economics	21	38,5
Medicine	11	2
Law	4,5	38
Sciences incl. Pedagogy	24,5	19
Arts	2	1
	100	100

The academic year 1993/1994 was chosen as a reference on purpose. Indeed, due to the appearance and the expansion of the private sector but also to the significant increase of degree programmes at the public universities, which occurred after 1990, the establishment of a legal basis for a system of accreditation and quality assurance of higher education institutions became a stringent necessity. This basis has been provided by the *Law on accreditation of higher education institutions and recognition of diploma* promulgated in 1993 and known as the Law 88/1993. Eventually, some amendments to the law were brought in 1999.

2. THE LEGAL FRAMEWORK OF THE ACADEMIC ASSESSMENT AND ACCREDITATION SYSTEM IN ROMANIA

The main provision of the Law 88 is the foundation of a National Council for Academic Assessment and Accreditation (NCAAA), placed under the control of the Parliament.

NCAAA is an independent, non-governmental body, serving as a buffer organization between the public authorities and the academic communities. NCAAA establishes as its permanent bodies evaluation commissions for various fields of higher education, composed of experts proposed by the accredited higher education institutions.

The process of academic assessment and accreditation, as defined in the Law 88, has two phases:

I. *the provisional operation license* which gives the right to organize admission of students and to conduct the educational process;

II. *the proper accreditation*, which gives, in addition, the right to organize the graduation examination and to confer diplomas recognized by the Ministry of Education and Research.

The assurance of the quality of the educational process is made by *periodic evaluation*.

When the Law 88 started to be enforced higher education institutions in Romania were grouped into two categories:

- higher education institutions set up before 22 December 1989;
- higher education institutions set up after 22 December 1989.

Higher education institutions set up before 22 December 1989 are viewed as having proved their viability and are considered to be accredited. For them the process of academic assessment and accreditation is based solely on *the periodic evaluation*.

On the other hand, universities faculties or specializations (degree courses), set up after 22 December 1989, both in the public and private sector, were required by the Law 88 to demonstrate that they meet the specified requirements. As a consequence, for them the above mentioned two phases and the periodic evaluation are applicable.

For the institutions which got the accreditation, the Government, through the Ministry of Education and Research, drafts the Bill on establishing the institution and sends it to the Parliament which considers and enacts a law on establishing the higher education institution.

3. CRITERIA AND STANDARDS

In Romania, higher education institutions shall function on the principle of non-profit and in accordance with a set of general criteria and compulsory standards stipulated by law.

The criteria refer to the fundamental areas of organization and functioning specific to any higher education institution: teaching staff, curricula, infrastructure for the education process and for the research, research activity, financial activity etc.

The standards correspond to each criterion and are indicative of the minimal levels which are compulsory in the evaluation and accreditation process. These levels are differentiated for the period of provisional functioning or for the period following the establishment by law of an institution.

Academic evaluation standards may be classified into two categories:

- standards which are explicit in law;
- standards which are not explicit but are enforced by law.

Each category contains quantitative and non-quantitative standards.

4. THE FUNCTIONING OF THE ACADEMIC ASSESSMENT AND ACCREDITATION SYSTEM

Based on the specified criteria and standards, NCAAA undertakes the phase I of the process, which is finalized by the granting or the refusal of *the provisional operation license* to the given institutions (for the new established institutions) on new specializations (programmes). *The provisional operation license* grants the right to organize entrance contents, to hire the teaching and auxiliary personnel and to conduct educational and research activities.

Institutions set up after 22 December 1989 were obliged to demand *the provisional operation license* not later than 6 months after the Law 88 was enacted.

The demand for accreditation should be made not later than 2 years since the third serie of students graduated after the institutions got *the provisional operation license*.

If the Reports of the NCAAA Evaluation Commissions are negative for all faculties, colleges and specializations of the institution concerned, by the decision of Government *the provisional operation license* is withdrawn for the institution as a whole, which thus enters in a process of liquidation beginning with the 1st year. If the Reports of the NCAAA Evaluation Commissions are negative only for some of the faculties, colleges and specializations of the concerned institution, only for them *the provisional operation license* is withdrawn and the liquidation process is initiated.

For accreditation purpose, the first three series of graduates of the higher education institutions which got *the provisional operation license* have to sustain the graduation (final) examination at the accredited faculties or colleges designated by NCAAA. To get the accreditation, besides other conditions stipulated by law is necessary that at least 51% of the total number of graduates of the first three series successfully pass the graduation (final) examination. For each of the serie, the rate of success should be at least 40%. When these conditions are not met, the faculty, college or specialization enters in the process of liquidation, starting with the 1st year.

As for the academic assessment the faculties, colleges and specializations are subjected to a periodical academic evaluation (every five years). If the Report of the NCAAA Evaluation Commission is unfavourable, a warning is sent by the Ministry of Education and Research to the concerned institution. If after an year the Report is also unfavourable, the Ministry decides the termination of enrolment for the faculty, college or specialization, starting with the 1st year.

5. OUTCOMES OF THE FIRST 7 YEARS OF NCAAA ACTIVITY

By 1st March 2001, the following data represent a synthesis of the intense and fruitful activity deployed by NCAAA since its foundation in 1993.

Public sector

In Romania there are 53 public universities.

The number of specializations (degree programmes or degree courses) for which *the provisional operation license* was demanded is 1369.

The number of specializations for which *the provisional operation license* was granted is 835.

The number of demands for accreditation is 278.

NCAAA proposed the accreditation for 261 specializations.

The number of specializations for which demands for periodical evaluation were made is 400.

Following the periodical evaluation, for 289 specializations the decisions to preserve the accreditation was taken. For other 106 cases, a decision of conditional preservations of the accreditation was taken.

Private sector

A total number of 128 private institutions have prepared self-evaluation reports and sent them to NCAAA, requesting *the provisional operation license* for 826 specializations.

NCAAA proposed to grant *the provisional operation license* to 86 institutions with 364 specializations.

35 institutions with 87 specializations have requested the accreditation.

For 18 institutions drafts bills on establishing were elaborated.

6. DATA ON ENGINEERING PROGRAMMES

NCAAA has two Evaluation Committees for engineering sciences which cover all engineering fields which are presently encountered in the structure of higher education institutions of Romania. General rules, as outlined in the paper, apply also to the engineering schools. In addition, several specific rules were defined and they have to be observed by the institutions seeking the provisional license or the accreditation.

As an example the item *"curricula"* is considered. For engineering fields, the following distribution of courses is compulsory:

- fundamental subjects, minimum 18% (from the total number of contact-hours);
- general technical subjects, minimum 30%;
- specialty subjects, minimum 30%;
- complementary subjects, maximum 8%.

For each engineering field a list of subjects is recommended. A ratio:1 is prescribed between the number of contact-hours devoted to lectures and those devoted to practical activities (tutorials, laboratories, projects a.s.o.).

In the public sector, a number of 272 specializations, belonging to 28 universities, were granted *the provisional operation license*.

In the private sector, only 5 specializations, belonging to 5 universities were granted *the provisional operation license*. In fact, the 5 specializations have the same title: Applied Informatics, belonging to the field Computer Science.

One can conclude that the offer of the private sector in the domain of engineering education is quasi non-existent. This is of no surprise at all. On one hand, the engineering education had until December 1989 a prevalent role in Romania higher education system (in the academic year 1989/1990, 66% of the Romanian students were enrolled in engineering programmes). On the other hand, the costs required for an engineering education (laboratories, equipment, materials a.s.o.) are very high. No wonder then that only the field of applied informatics, became interesting for the private sector, which used the infrastructure of former research and computer centres in search of privatization.

7. CONCLUSIONS

In the transition period faced by the Romanian society, the problems of the higher education are numerous and complex. The need to adapt Romanian higher education to international standards of excellence and the emergence of a large number of private higher education institutions have underscored the need to create a system of academic assessment and accreditation. There are more than seven years since the implementation of the system. A very good experience was acquired, which was worth to be briefly described.

THE EVALUATION PROCESS OF THE FINNISH AND SWEDISH MSc PROGRAMMES IN CIVIL AND ENVIRONMENTAL ENGINEERING

Soile Koukkari[1] & Seppo Hänninen [2]

ABSTRACT: *During the year 1997 the MSc programme in Civil and Environmental Engineering of Helsinki University of Technology (HUT) and all the Swedish MSc programmes were evaluated. The evaluation was initiated by the Co-ordination Body of the Presidents of the Swedish Universities of Technology and by the Rector and the programme management of HUT. The evaluated Swedish programmes were Chalmers University of Technology (CTH), the Royal Institute of Technology (KTH), Luleå University of Technology (LTU) and Lund Institute of Technology (LTH).*

The evaluation comprised the study programmes' self-assessments, which were based on a checklist of questions to be answered compulsorily or voluntarily, the Evaluation Group´s interwievs at the universities with representatives of the management, teaching staff, students, senior faculty administrators, educational planners, and the student counselling service of the different programmes, and a final report.

The evaluation report consists of three main parts. The first of these presents some background facts for the evaluation. The second part covers some comprehensive issues common to all the study programmes, while the third part treats such issues that are specific for the individual programmes.

The main aim of the evaluation has been to provide inspiration, recommendations and support for further development of the quality and efficiency of the Civil and Environmental MSc programmes. It has therefore been important to strive to structure and organise the evaluation so that it might be experienced as a part of the continuing development of the study programmes. The significance of this was also emphasised before self assessments.

A comparative analysis of the educational structures in Finland and Sweden could probably, in the opinion of the Evaluation Group, enhance the quality of both educational models.

In this article the Evaluation Process is presented according to the final report "Utvärdering ac civil- och diplomingenjörsutbildningarna i samhällsbyggnadsteknik och väg- och vattenbyggnad i Sverige och Finland" by the evaluation group.

1. INTRODUCTION

The main aim of the evaluation has been to provide inspiration, recommendations and support for further development of the quality and efficiency of the Civil and Environmental MSc programmes. It has therefore been important to strive to structure and organise the evaluation so that it might be experienced as part of the continuing development of the study programmes. The significance of this was also emphasised before self assessments.

[1] Faculty secretary, Helsinki University of Technology, Finland
[2] Planning officer, Department of Civil and Environmental Engineering, Helsinki University of Technology, Finland

The Evaluation group has identified the following factors as crucial for the quality of a study programme:
- the educational objectives for the different levels – study programme, specialisation, course and degree project levels - the interconnection of objectives and strategies for achieving them;
- the programmes connection to research;
- the internationalisation of the programme;
- the competence, pedagogic skills and attitudes of the lectures;
- the students´ knowledge prior to admission, capacity and attitudes;
- the teaching methods and examination modes;
- the organisation and examination modes;
- the organisation and administration of the programme;
- the resources available to the programme and how they are utilised;
- the co-operation with and the feedback from the surrounding world (potential employers of graduates)
- the systems for continuous follow-up and evaluation activities in relation to the objectives set up and using internationally recognised quality criteria.

The target groups of the evaluation were:
- the presidents of the universities of the technology who commissioned The Evaluation Group;
- the study programmes evaluated, which could initiate internal and jointly held discussions, as well as internal and jointly implemented measures, based on the conditions, the ideas and recommendations presented in the report for all the programmes;
- graduates from the programmes, academies, associations and organisations taking an active interest in educational issues, such as the Nordic academies of engineering sciences, The Swedish Society of Civil and Structural Engineers (SVR), the Association of Finnish Civil Engineers (RIL), etc.

The evaluation report consists of three main parts. The first of these presents some background facts for the evaluation. The second part covers some comprehensive issues common to all the study programmes, while the third part treats such issues that are specific for the individual programmes.

2. SOME BACKGROUND FACTS FOR THE EVALUATION

2.1 Paradigmatic shift

The process of transformation taking place in the sector of civil and environmental engineering seems to be so radical that it should be described as a paradigmatic shift. The transformation process can in short be characterised by the following features:
- extensive specialisation and advanced expertise;
- simultaneous expansion and structural transformation of the sphere of activity (repair, reconstruction and extension of buildings, maintenance, operation and management are becoming more important);
- increased internationalisation, a clear Europeanisation;
- a large-scale development towards function-based regulations and towards certification of quality;

- increasing responsibility for the consequences of construction for man and society (economics, more efficient use of energy, environmental control, sustainable development, dismantling and re-use);
- the rapidly increasing importance of information technology (IT) as an integrated tool in the construction and management processes.

2.2 Structure and contents of the study programmes

The Swedish programmes lead to the degree of MSc (180 study points) and their nominal duration is 4,5 years. The programmes have a similar structure, consisting of a compulsory core programme of courses in mathematics and natural sciences and basic courses in the engineering sciences, a block of in-depth courses, as a rule provided in different kinds of specialisation options, completely optional courses, and a degree project (resulting in a master`s thesis). The scope and contents of the courses in mathematics and natural sciences on the programmes evaluated correspond relatively well, while the design of the basic courses in the engineering sciences differs considerably between the programmes. There are also great differences between the programmes with regard to general courses providing a broader educational perspective, which can vary between 1-16 study points.

The Finnish programme also leads to an MSc (180 points), just like the Swedish programmes, but has a nominal duration of 5 years. In comparison with the Swedish study programmes, the Finnish programme has a different structure, comprising in chronological order, a large core programme of courses, a smaller specialisation option, a group of optional courses, a major and a minor subject, and a degree project (resulting a master`s thesis). Through the parallel studies in the major and minor subject, which cover one academic year, the Finnish programme emphasises the demand for extensive studies.

2.3 Enrolment planning – recruitment

The dramatically reduced attractiveness of the civil engineering programmes is extremely serious for the provision of competence in this sector. If this negative trend is to be broken, extensive work must be carried out to renew the study programme, and strenuous efforts must be made to market programmes. In this connection, extensive co-operation is necessary between the universities and the players in the sector. Recruitment must be promoted by information campaigns aimed at arousing the interest of prospective students in university programmes in civil engineering. Information must also be provided for groups of people who play an important role in influencing young people, e.g. teachers, careers, guidance officers, journalists and politicians. /Utvärdering/

2.4 Resources

The undermining of resources has resulted in a trend towards a lower lecturer-student ratio and larger student groups, leading to a lower level of classroom teaching, less suitable conditions for individualised tuition, more self-tuition, less laboratory work, fewer field studies, changed conditions for course development, and avoidance of time-consuming and costly modes of examination. /Utvärdering/

The dramatic cutbacks in resources for undergraduate education have, to a considerable extent, obstructed and delayed an important enhancement of the quality of the programmes. Moreover, additional cutbacks would inevitably produce very serious consequences for the standard and international competitiveness of the study programmes. /Utvärdering/

3. ISSUES OF GENERAL RELEVANCE TO ALL STUDY PROGRAMMES

3.1 Conclusions drawn from the self-assessments

It is the opinion of the Evaluation Group that, if the self-assessment is to become an important part of the quality enhancement process of the study programme, very clear instructions are required, with distinctly formulated tasks and questions, and continuous co-operation between the Evaluation Group and those responsible for the self-assessment during the whole of the self-assessment process.

To achieve good quality in a study programme and to ensure the programme`s continuous quality enhancement, everyone involved in the educational process must be quality-conscious and strive to fulfil the objectives set up. Assessing the extent to which objectives are fulfilled requires the objectives to be operational. In this connection, the application of well-defined indicators can provide quantitative measures which indicate indirectly the degree of qualitative target fulfillment. The development and implementation of quality programmes and strategies for realising these are important instruments for achieving co-ordinated quality enhancement for different forms of activity and different levels.

At the universities of technology, considerable efforts have been made during the past five years and a great deal of work is now in progress to develop visions and mission statements and to draw up quality enhancement programmes with concomitant strategies for different forms of activity and different levels. The evaluation group emphasises the importance of giving incentives that promote development (such as promotion, rewards, greater resources, and clear career paths) a central role when drawing up quality programmes. It is also important that quality programmes should include or be supplemented with systems for following up and monitoring, on the central level within the universities, how the overall strategies, quality objectives and productivity objectives are used in the process of quality enhancement on the faculty, study programme and department level.

3.2 Structure and contents of the study programmes

All of the study programmes evaluated have introduced new syllabuses during the past four academic years. The main aim of this process of renewal has been the same for all programmes, but most clearly formulated for CTH`s CE-programme, namely:

- to provide students with improved opportunities of pursuing in-depth studies;
- to increase the students` freedom of choice in the syllabuses;
- to fuse courses/parts of courses into larger units to enable students to experience their study - programme as a coherent whole and increase their understanding of their subjects;

- to supplement the study programme with new fields of knowledge;
- to provide students with greater opportunities of personal development, as a basis for continuous learning and competence development.

The Evaluation Group considers the renewal of the syllabuses to be a very important contribution to the enhancement of the quality programmes.

3.3 Degree project – leading to a master`s thesis

Through their degree project, which is the most important individual project of the study programme, students are to demonstrate that they have fulfilled the overall objectives of their programme. It is therefore necessary to establish a clear connection between these objectives and the requirements specified for the degree project.

3.4 Pedagogy in engineering education

During recent years obvious changes have taken place in higher education concerning views on learning and on teaching methods. Such changes have also taken place at the universities of technology. The new perspective in pedagogy is derived from a shift in focus from teaching to learning. The thinking process of students and their apprehension of knowledge are central elements of the new pedagogy, which requires different approaches and teaching methods than previously.

3.5 The international perspective

Current developments in technology and industry are characterised by the erasure of national borders. The Evaluation Group has devoted its attention to the necessity for universities to prepare their students for working on the international scene, and has compiled information on how different universities have adapted their programmes to this necessity.

The exchange of lecturers and students with foreign universities is an excellent means of providing international experience. Statistics show that around 25 % of students in Finland and Sweden spend one term (half a year) or more studying at a foreign university, while a much smaller number of foreign students study in Finland and Sweden. The students themselves state that academic breadth, cultural aspects and learning a foreign language are their most important reasons for studying abroad. All the universities evaluated have organised their provision of information to students on the objectives of studying abroad and the opportunities available to students. The universities differ considerably concerning the ways in which they handle student exchange and have thus a good opportunity to learn from each other´s experience.

3.6 Contact with the surrounding world – co-operation with potential employers of graduates

The world surrounding the university and co-operation with potential employers of graduates are becoming increasingly important. The potential employers of graduates from the programmes – i.e. the customers of these programmes – are mainly to be found in building and property sector, whose task can be described as meeting the needs of individuals, trade and industry, and society concerning housing and premises, functioning infrastructure, and a good built environment.

One characteristic of the building and property sector is that it contains a great number of different players, in the form of private companies and associations of companies, public authorities and publicly owned companies. The sector mainly consists of small businesses, but is dominated by a few big companies within each group of players; examples of such groups being building proprietors and property managers, technical consultants, entrepreneurs, and the construction material industry.

Co-operation is important. The students are asking for contacts with working life. It is also important that potential employers should participate in the process of formulating and providing information on objectives, and making the identity of the programmes distinct, with regard their name, academic level and characteristics. Recruitment is a crucial issue for all parties, and it is important that all parties should take joint measures to strengthen the image of the sector. It is also important that the players in the sector should assume joint responsibility for a solution to the problem of arranging practical trainee works.

3.7 Undergraduate education, postgraduate education and research – a cohesive system

The assignment of the Evaluation Group has not comprised any investigation or assessment of university research in the fields of environmental engineering and civil engineering, or any more detailed analysis of the extent to which research and research results are utilised in undergraduate education. The Evaluation Group recommends the programme managements to prepare for the future by having such an analysis performed, as a basis for further development of the quality of undergraduate education. The Group also recommends that future evaluations should be extended to perform integrated studies of undergraduate education, postgraduate education and research.

4. CONCLUSIONS

The Evaluation Process was very useful for the HUT`s MSc programme. It started an active discussion of the quality of the learning and research work. In the department the project of developing of teaching started 1999. It is financed by the Ministry of Education. The Ministry of Education has also financed the internationalization project of the HUT`s MSc programme during 1999-2001.

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ASSESSEMENT OF THE TEACHING–TRAINING SYSTEM IN A CIVIL ENGINEERING INSTITUTE

Iuliu Dimoiu[1]

ABSTRACT: *The paper presents the main parts of the teaching-training process. It highlights the corresponding features of this process that can be assigned from interior of the educational institute. The investigation of these features leads to the qualitative linguistic terms. Furthermore the translation of these terms into the fuzzy variable is presented and exemplified. One of the qualitative criterium of the teaching-training process is detailed. At the same time a mathematical model for the teaching-training process is formulated as an optimum problem.*

1. NECESSITY OF RECURRENTLY ASSESSEMENT

The education system is one of the main factors in the training of the labour force wanted by the social system. The dynamics of the economic system and scientific research results asks for new professions and the conversion of old ones. Therefore, the educational system has to overtake the requests for labour force wanted by the work market. The social system imposes the setting up for the new educational institutes and the up grading of the old ones. Here are a couple of questions. Is the setting a good one? Are the graduates prepared to do an efficient work? Do the graduates become conspicuous? The graduates` ability is checked during the professional practice, in other words, the mark of the teaching – training process is assigned a posteriori and outwardly. The graduates` skill is a remark for the educational establishment. It could or not, be attractive for the newcomers. The teaching – training system should be recurrently self – assessed in checking its correspondence with the market demand. The self – assessment is devoted to both kinds of establishment, the new and the old one.

2. QUALITATIVE ASSESSEMENT

The component parts of the educational institute are analyzed and assessed by different qualified committees. Sometimes, special tests are performed on more or less homogeneous population. Is this an unbiased practice? The answer is not! The answer undergoes the emotional factor influence, the variation of environmental features, the biological rhythm. The quality classification is done by the help of linguistic terms, which are not able to do a sharp delimitation. Whether some features of teaching – training process can be numerically counted, the great majority is irresolute characterized. A couple of such linguistic terms are noticed in Table 1. On the same line, Fig.1 shows few epithets with partial superimposed meaning aria. Consider a feature of teaching – training process. A linguistic mark is assigned to it. But this mark has not a distinctive separable power. Thus, the noticed feature can be considered as a

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variable one. Therefore different evaluating teams could assign to this feature linguistic marks with more or less close meaning.

Table 1 Linguistic terms used for quality assessment

Positive meaning	**Ambiguous meaning**	**Negative meaning**
Acceptable	Adequate	Insufficient
Attractive	Innovator	Inadmissible
Adequate	Inadmissible	Insignificant
Correlative	Old - fashioned	Ineffective
Comprehensive	Quite–right	Loose
Efficient	Ridiculous	Minimal
Excellent	Fairly well	Poor
Good		One sided
Renewed		Obsolete
Up graded		
Very good		

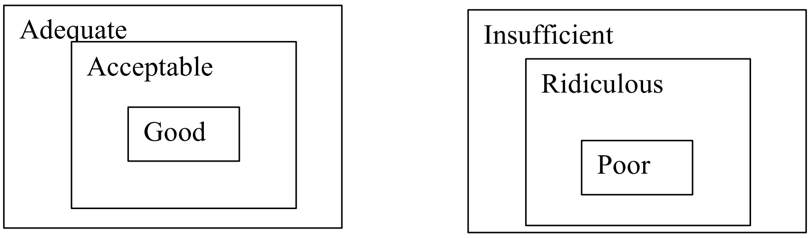

Figure 1 Linguistic terms with close meaning

3. ELEMENTS OF FUZZY LOGIC

Traditional logic or binary logic, the most popular one, estimates the quality by two exclusive values: true=1, false=0. There exist logical variables that can have n definite values. Such a variable is assigned to the values of the set:

$$\left\{0, \frac{1}{n-1}, \frac{2}{n-1}, \frac{3}{n-1}, ..., \frac{n-2}{n-1}, 1\right\}$$

For logical variable with a continuous domain of definition, or with infinity number of values the so-called Fuzzy logic is applied. An element of a fuzzy set can take one value in the range [0,1]. This means, a variable can have intermediate degree of affiliation between the exclusive value 0 and 1. The following formula is defined on the fuzzy set: i) any fuzzy variable is a fuzzy function; ii) if F, G are two fuzzy functions, then “F and G” (F$\wedge$G), “F or G” (F V G) is a fuzzy function; iv) if F is a fuzzy function then “non F” (F) is a fuzzy function; v) there exist no other fuzzy function. The logical value A (F) of a fuzzy formula F satisfies the axioms: 1) if F=G then A (F)=A (G); 2) A (F and G)=min [A (F), A(G)]; 3) A(F or G)=max [A(F),A(G)]; 4) A(non F)=1- A(F). The laws of binary logic are valid for the fuzzy logic, too. There is no syntactic distinction between formulas belonging to binary or fuzzy logic, respectively.

4. FUNDAMENTAL PARTS OF THE EDUCATIONAL PROCESS

The essential parts of the teaching–training process of civil engineering range are shown in Figure 2.

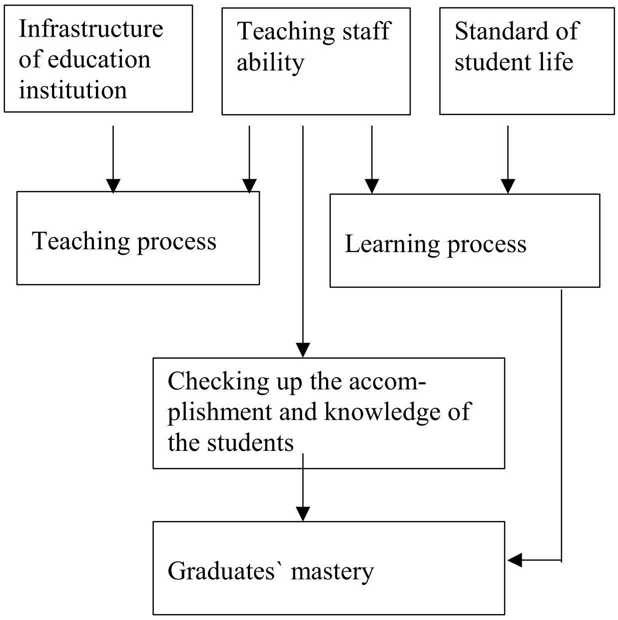

Figure 2 Constitutive part of educațional process for assessment

4.1 Infrastructure of educational institution

The starting line of the teaching – training process consists in endowment of high – school institution. A couple of infrastructure features can be numerically counted and the result is expressed as item/student, e.g. m^2/student, kwh/student and s.o. But there are many other features that are characterized only in linguistic terms as shown in Figure3.

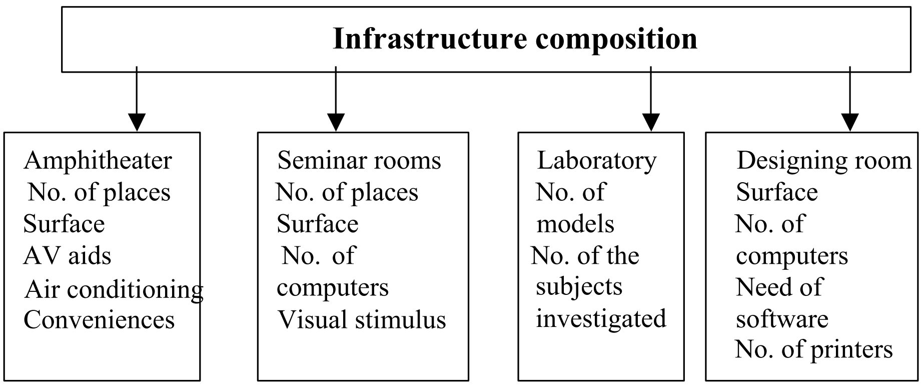

Figure 3 Features of the infrastructure of an educational institute

Every part of the infrastructure allows us to define the variable: quantity–Q, using age-UA, and serviceability–S. Amphitheatre is or is not roomy, with or without audio-video aids, with good or with bad visibility at the board used. The team of experts can characterize the amphitheatre by words: insufficient–INS, acceptable–ACC, adequate–AQ, good–G, very good –VG, excellent–EX. Others terms could be: absent–AB, obsolete–OB, up – to – date-UTD and s.o. The laboratory exigencies are many and sternly. Except the questions noticed in Fig.3 other questions arise: Do the laboratory works cover the subject necessities? Are there sufficient recording and processing stations? The summation of the answers to such requirements allows assigning the linguistic terms (logical values) to the given laboratory: inadequate–IN, incompatible–IC, acceptable–ACC, good–G, very good–VG, excellent–EX and s.o. The half–yearly project, yearly project or final project, which is developed in a special room, provides data for an assessment by the terms:

- quantity aspect-Q: under low expectation–ULE, minimum–MIN, insufficient–INS, incomplete–INC, sufficient–SF, plentiful–PF, redundant–RD
- actual age A : very old–VO, obsolete-OB, adequate–AQ, up to date–UTD
- serviceability aspect-S: adopted–AD, adequate–AQ, specially made-SM

As it can be seen the linguistic terms are assigned to the logical variable: quantity, age and serviceability. An indicator can be defined related to the one of infrastructure part of the educational process:

$$I_{IF} = (Q - \text{and} - A - \text{and} - S) = \begin{cases} \text{Minimum} \\ \text{Adequate} \\ \text{Good} \\ \text{Very} - \text{Good} \end{cases}$$

4.2 Teaching staff

The teaching staff is the most efficient component of the teaching – training process. The professional structure of the teaching staff is computed by the number of professors, assistant professors, lecturers, assistants, and doctoral applicants. The spreading of these qualifications on the subjects attached to a Department, Faculty or University could be ungrateful–UG, acceptable–ACC, well done–WD, very well done–VWD, and s.o. The pedagogic ability of the teaching staff is of a great importance. The educational process generally flows from the teacher to the student. The teacher should do his job so that the students at least accept and respect him. Ideally, the teacher could become a life model for the students. The pedagogic ability of a teacher can show a teacher:

- with or without teaching sense; -with dignity or with compromise; -patient or hot – blooded; - acceptable for questions and interruptions or insufferable one

Summing up these features, a member of the teaching staff could receive one of the marks: master or hesitant of the subject, realistic or monopoly for the true, innovator or obsolete and s.o. The three fuzzy functions defined above, are professional qualification–PQ, pedagogic ability–PA and teaching practice–TP. They could be assigned by logic terms (fuzzy variable) with numerical value in the range [0,1]. The indicator of the teaching staff quality joining the three fuzzy functions above defined is:

$$I_{TSQ} = (PQ - \text{and} - PA - \text{and} - TP) = \begin{cases} \text{Insufficient} \\ \text{Acceptable} \\ \text{Good} \\ \text{Very} - \text{Good} \end{cases}$$

This indicator refers both to every member and to the entire teaching staff.

5. TEACHING PROCESS

The teaching staff performs the main activities shown in Figure 4. A couple of linguistic terms are attached as a mark to everyone. The lecture belongs to the teacher and depends on its qualification and pedagogic ability. The seminar activity could be developed in different ways: only by the teacher or only by the student or interactively teacher – student. The seminar activity supposes the preparedness of both involved parts: students and teacher. The teacher leads controls and emphasizes the main knowledge and conclusions. The project activity is a cooperative one between the student and the supervising teacher. At the begining of the yearly project activity, the teacher is the main person of the project statement. After this stage, the teacher becomes a leader for good and available solutions, for innovative and feasible ones. The pedagogic ability and professionalism of the teacher could conduct to the predicted aim. The final project belongs exclusively to the student. The supervising teacher is a counsellor regarding the alternatives, reliability and acceptance of the technical solutions.
Checking the knowledge and professional ablility of the students is an event. Both parts, techer and students are involved. The environment and the aim of the examination, the pedagogic ability of the teacher can undoubtedly develop the judgement, knowledge and skill of future graduates. Based on Fig.4 , every kind of activity can be characterized by a couple of linguistic terms which may be translated into a number of the domain [0,1]. The result can be: under low expectation–ULE, with lacks and deficiences–LD, adequate–AQ, good–G, very good–VG, excellent–EX.

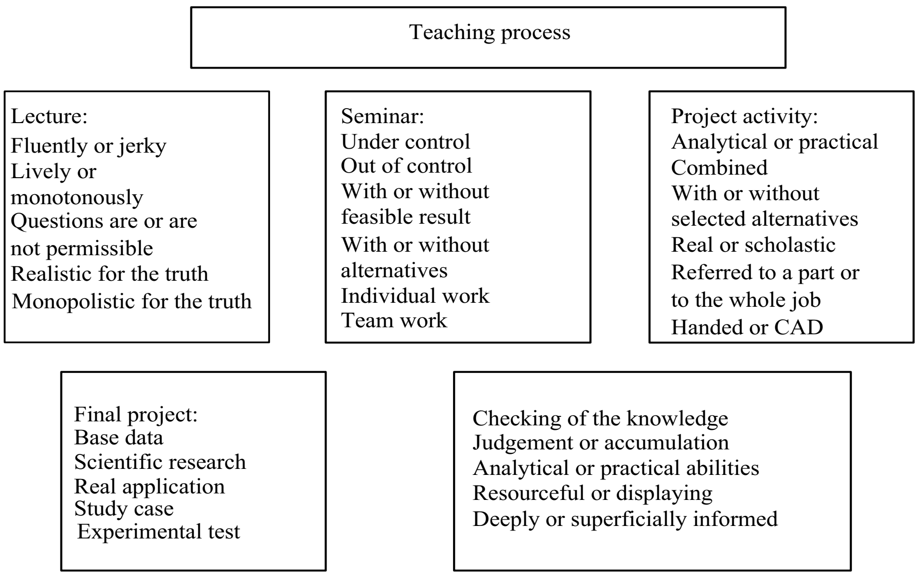

Figure 4 Some main parts of the teaching process

The indicator of teaching process is a fuzzy function. It consists of teaching – T, learning–L and checking–C. They are illustrated in Fig.5.

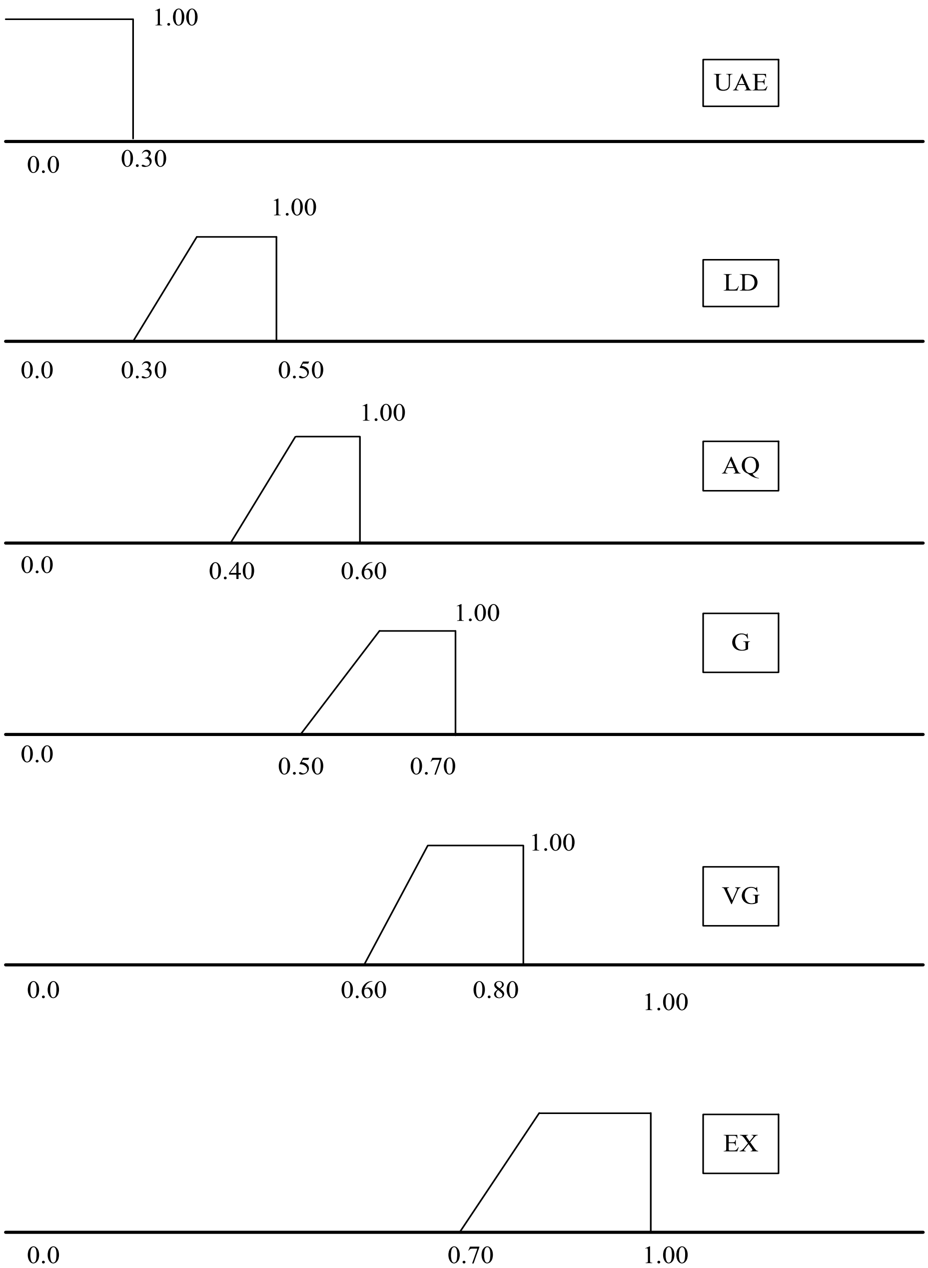

Figure 5 Fuzzyfication of a Feature of Teaching Process

6. MANAGEMENT OF CURRICULA

One of the main part of the teaching process is the curriculum. The subjects included, the proportion among the fundamental disciplines, the special subjects, the economic ones is a determinant number. The proportion between the compulsory subjects and the optional ones is another main number for the curricula. These above mentioned aspects are numerically displayed.

$$I_{TP} = (T - \text{and} - L - \text{and} - C) = \begin{cases} \text{Insufficient} \\ \text{Adequate} \\ \text{Good} \\ \text{Very} - \text{Good} \end{cases}$$

A question arises: are these numbers the optimum ones? A certain number of hours is devoted to every subject. Is this number an adequate one? It can be small, acceptable, adequate or exaggereted. The subjects included in the curricula could be out–of–date, quite good, adequate, up – to – date. The succession of the subjects may or may not adequate, acceptable, optimum and s.o. All the above mentioned epithets are fuzzy variable. The features such as number of hours, succession of subjects, proportion among subjects is a fuzzy function

A graph is built for every fuzzy variable. The values of these variables is in the domain [0,1]. Joining the graphs of all fuzzy functions an indicator of curricula quality is find out.

$$I_{CURRIC} = \begin{cases} \text{Non} - \text{Adequate} \\ \text{Acceptable} \\ \text{Good} \\ \text{Very} - \text{Good} \end{cases}$$

7. FUZZYFICATION OF CURRICULA

Let curricula quality be a fuzzy function. It is determined by the fuzzy variable (linguistic terms) such as: under any expectation–UAE, with lacks and deficiencies–LD, adequate–AQ, good–G, very good–VG, excellent–EX, A graph is shown in Figure 5 for each of this fuzzy variables. Here the rectangle and the trapezoid are used, but a singleton, a triangle, a cosine or other forms can be adopted for the fuzzy variable. This is the investigating team decision.

If a given curricula is under the test and 0.56 is the normalized value thus obtained, the curricula quality has the following degrees of appearance:

A(UAE)=0 ; A(LD)=0 ; A(AQ)=1; A(G)=0.5 ; A(VG)=0 ; A(EX)=0 ;

8. FUZZYFICATION OF A SUBJECT

Let N_{STUD} be the number of the students that have been attended the teaching subject forms (lecture, seminar, project). At the end of all teaching forms activity, a written test as shown in Table 2 is completed by every student. The best mark corresponds to 157 and the worst mark to 45. The mark of the subject is:

$$M = \frac{1}{N_{STUD}} \sum_{K=1}^{K=N_{STUD}} M_K$$

The assigning team establishes the fuzzy variables and their domain of definition as follows:

$$QS = \begin{cases} UAE \ldots\ldots 45 \le M \le 67 \\ INS \ldots\ldots 56 \le M \le 90 \\ ACC \ldots\ldots 67 \le M \le 101 \\ AQ \ldots\ldots 78 \le M \le 112 \\ G \ldots\ldots 89 \le M \le 123 \\ VG \ldots\ldots 101 \le M \le 134 \\ EX \ldots\ldots 112 \le M \le 157 \end{cases}$$

The true value for this fuzzy function QS is given below:

$$A(QS) = \begin{cases} A(UAE) \in [0.0 - 0.2] \\ A(INS) \in [0.1 - 0.4] \\ A(ACC) \in [0.2 - 0.5] \\ A(AQ) \in [0.3 - 0.6] \\ A(G) \in [0.4 - 0.7] \\ A(VG) \in [0.6 - 0.9] \\ A(EX) \in [0.8 - 1.0] \end{cases}$$

Table 2 Test performed by students participating to subject forms

Nr	Positive estimation		Negative estimation		Mark
	The best quality	Mark	The worst quality	Mark	
A	The Lecturer				
1	Clearly audible	4	Inaudible	1	
2	Lively	5	Monotonous	1	
3	Interested in students	4	Not interested in …	1	
4	Well organized	5	Muddled	2	
5	Interprets ideas, theory	5	Leaves me confused	2	
6	It interested me	5	Bores me	2	
	…………	…	…………..	….	
B	The subject matter				
1	Easy	5	Difficult	2	
2	Nothing much in it	5	Too much material	2	
3	Useful to me	4	Waste of time	1	
4	Interesting	5	Boring	1	
5	I will do further study	5	I will not pursue it	1	
C	Audio-Visual Material				
1	Used too much	4	Not used enough	3	
2	Overhead projector: easy to read	4	Illegible	1	
3	Used too much	4	Not used enough	2	
4	Sufficient time to read plastics	3	Insufficient time to read	1	
	……………	….	……………	….	
D	THE LECTURES SERIES				
1	Good progression	5	Poor progression	1	
2	Lectures well prepared	5	Not well prepared	1	

For example: 85 is the medium mark of a tested subject, or 0.36 in the normalized domain. The value of subject quality, based on Fig.6, is: A (ULE)=0; A (INS)=0.95; A (ACC)=0.76; A (AQ)=0.40; A (G)=A (VG)=A (EX)=0;

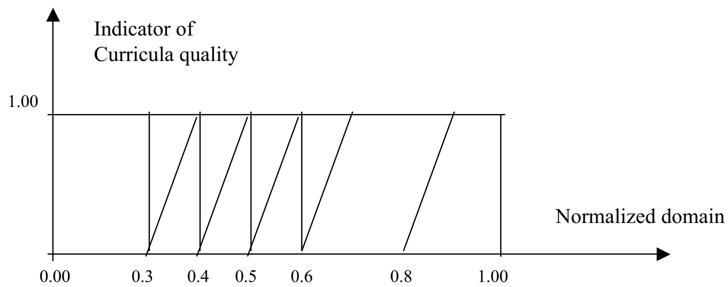

Figure 6 Fuzzyfication of curricula

9. LEARNING AND UPTAKING PROCESS

The student with its feelings, qualities, ambitions and deficiencies is the essential element of the teaching – training process. He can be relieved and still modeled so that he acquires the basic notions of the civil engineering profession.
The university library, the professional laboratories, the computer laboratories and the student life standard are determinant in the learning process. The university management may be deeply involved in arising the standard of these segments.The term - university library - can be formulated as fuzzy function characterized by the fuzzy variable: the book endowment, the access posibility, the reading rooms, the renewal book stock, and s.o. The laboratories, esspecialy the computer laboratory are of the most interest for the majority of students, nowadays. This term formulated as a fuzzy function depends on the input fuzzy variables: the number of computers, the age of the soft ware and devices, the potential of the soft ware and s.o. The students` life standard is given by the accommodation condition, feeding possibilities, recovery facilities. All of these, may be formulated as fuzzy functions. Fuzzy variables are specially for each of them. For example the quality of students` life standard can be assigned by linguistic terms: hard, unsatisfactory, acceptable, good, confortable, very good and life of leisure. A fuzzy graph shouled be built for each of these fuzzy variables. Joining the above mentioned graph, the fuzzy graph for the life standard is found.

10. A MATHEMATICAL MODEL OF TEACHING – TRAINING PROCES

The qualitative internal evaluation of teaching – training process is a large activity of a long standing. Members of few non – homogeneous skill populations perform this activity. Being applied on a complex range it is influenced by psychological and emotional feelings. The sujective elements of the qualitative assessement results should be filtered. The translation of the educational process evaluation into a mathematic model allows to give an objective character to the internal evaluation. In the framework of a logic model, the fuzzy varables and functions should be stated. Their minium acceptable values should be a priori established. An overall sketch, shown below, is emphasized.

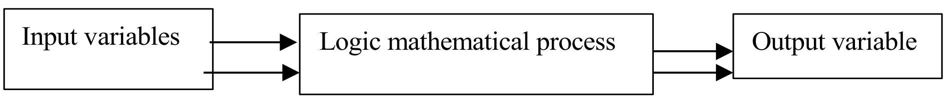

Figure 7 Global scheme of evaluation process

If the main features of the teaching–training process are expressed in fuzzy logical form, the quality can be formulated as a multicriteria optimum problem. The statement of he problem sounds: Find the values of input variables X_i, $i=1,n$ subjected to the restraints: i) restraints of the individual variable: **$0 < X_i < A_i < 1.00$;** ii) fuzzy function restraint: $0 < F_k(X_1,X_2,\dots,X_n) < B_k < 1.00$; $k=1,m$ so the scope function: quality indicator functions of the teaching – training process should be maximum: $I_p(X_1,X_2,\dots,X_n) \rightarrow \max$; $p=1,q$. The restraints: i),ii) and the scope functions are logic expressions in which the fuzzy variables are connected by a logic operator: AND, OR, NON.The restraints: ii) and the scop functions are logic expressions in which the fuzzy variables are connected by a logic operator: AND, OR, NON. The solution of the problem establishes adequate values of the logic variables. But these variables correspond to some real parameters involved in the teaching–training proces. As a result the university manager is well informed about the needs that must be satisfied. This kind of educational process assessement can offer the answer a difficult question: What should be done if the education quality is very good but still is not enough?

11. ORGANIZING ACTIVITY OF ASSESSING TEAM

In the framework of interior assessement of the teaching–training process the team is authorized to establish the following: component part and features of the teaching–training process; component parts and features which are of the competence of the analysing team; the linguistic terms in characterising the features; the minimum accepted value of every fuzzy variable; fuzzy variables that are implied by the others and the sens of impling; indicators of quality and the minimum values accepted; assigning process plan; special test for every feature; sort of population to be tested; minimum number of this population; graph of every fuzzy variable; processing the recovered tests; finding the values of quality; solving the optimum design problem to determine the element should be improved.