INQUIRIES INTO EUROPEAN HIGHER EDUCATION IN CIVIL ENGINEERING

SOCRATES - ERASMUS
THEMATIC NETWORK PROJECT

EUROPEAN CIVIL ENGINEERING EDUCATION AND TRAINING

EUCEET

THIRD EUCEET VOLUME

Edited by
Iacint Manoliu

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PREFACE

This is the third 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 is divided in five parts.

Part I, dealing with general issues, contains an overview of project activities in the third year (2000-2001) and in the dissemination year (2001-2002).

Parts II, III, and IV of the volume were prepared by the EUCEET Working Groups D, E and F, respectively. In each part, the synthesis of activities undertaken by the Working Group is followed by the final Report of the Working Group.

In part V presentations of the three EUCEET Fora organised in the dissemination year are given.

The editor expresses his gratitude to the authors of the Reports, and to all active partners of EUCEET Consortium for theirs contribution and support.

Professor Iacint Manoliu

Secretary General of the EUCEET Steering Committee

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PART ONE

GENERAL ISSUES

EUCEET in 2000/2001 and 2001/2002

Marie-Ange CAMAROTTA
E.N.P.C. Paris (FR)
Iacint MANOLIU
T.U.C.E. Bucharest (RO)

EUCEET IN 2000/2001 AND 2001/2002

Prof. Marie-Ange CAMMAROTA
Ecole Nationale des Ponts et Chaussées, Paris

Prof. Iacint MANOLIU
Technical University of Civil Engineering, Bucharest

In the introductory paper for the First EUCEET Volume, a presentation of EUCEET activities in the first two years (1998/1999 and 1999/2000) was made. It is, therefore, appropriate to open this new EUCEET Volume with a overview of EUCEET activities in the third year (2000/2001) and in the dissemination year (2001/2002).

1. EUCEET in the third year (2000/2001)

A chronology of the meetings which took place in the third year of the Project (1 September 2000 – 31 August 2001) is given in the table 1.

Table 1

EUCEET meetings in the 3rd year	
Date, venue	*Content*
19-21 October 2000, Thessaloniki	2nd meeting of the Working Group E
27 October 2000, London	3rd meeting of the Working Group F
8 December 2000, Budapest	6th meeting of the Steering Committee
19 January 2001, Barcelona	3rd meeting of the Working Group D
22 February 2001, Constantza	4th meeting of the Working Group D
1 March 2001, Paris	4th meeting of the Working Group F
2 March 2001, Paris	7th meeting of the Steering Committee
3 May 2001, Trondheim	5th meeting of the Working Group D
4 May 2001, Trondheim	8th meeting of the Steering Committee
11-12 May 2001, Porto	5th meeting of the Working Group F
15 July 2001, Sinaia	9th meeting of the Steering Committee
13-17 July 2001, Sinaia	3rd EUCEET General Assembly and EUCEET-ECCE International Conference

As in the previous report, in what follows details will be provided only for the meetings of the Steering Committee. Reference to the meetings of the Working Groups are made in the reports prepared by the WGs for this volume.

As for the General Assembly and the EUCEET-ECCE Conference "*Challenges to the Civil Engineering Profession in Europe at the Beginning of the Third Millennium*", Sinaia, 13-17 July 2001, an entire volume, the second EUCEET volume, was devoted to these events.

However, in order to have a complete picture of the 3rd EUCEET year, a brief report on Sinaia events is also included.

• *The 6th meeting of the Steering Committee, Budapest, 8 December 2000*

The meeting was organised and hosted by Budapest University of Technology and Economics and was attended by the following members: Prof. Marie-Ange Cammarota, ENPC Paris, Coordinator; Dr. David Lloyd Smith, Imperial College London, Deputy Coordinator; Prof. Iacint Manoliu, TUCE Bucharest, Secretary General; Prof. Laurie Boswell, City University London; Prof. Jose Manuel Pinto Ferreira Lemos, University of Porto; Prof. Manfred Federau, Engineering College of Odense; Prof. Jose Luis Juan-Aracil, ETSICCP Madrid; Prof. Richard Kastner, INSA Lyon; Prof. Josef Machacek, Czech Technical University, Prague and AECEF; Prof. Benjamin Suárez Arroyo, Technical University of Catalunya.

The meeting was also attended by a number of representatives of partner institutions, namely: Mr. Colin Kerr, Imperial College London; Prof. Ryszard Kowalczyk, University of Beira Interior; Prof. Vaclav Kuraz, Czech Technical University; Prof. Nicoleta Radulescu, TUCE Bucharest, Deputy member of the EUCEET Executive Board; Prof. Peter Ruge, Technical University of Dresden; Prof. Ivan Totev, University of Architecture, Civil Engineering and Geodesy of Sofia.

The Budapest University of Technology and Economics was represented by Prof.Györky Farkas, Dean of Civil Engineering Faculty; Prof. Antal Lovas; Assoc. Prof. Istvan Bodi.

In the first session, Prof. Marie-Ange Cammarota, made a comprehensive overview of the financial situation of the project.

The new academic partners for the 3rd year of the project are:

ENTPE Vaulx en Velin – FR
Universita degli Studi Firenze – IT
Lund University – SE
School of Civil Engineering Nottingham – UK
University of Architecture, Civil Engineering and Geodesy of Sofia – BG
Brno Technical University – CZ
Politechnika Bialostocka, Byalistok – PL
Politechnika Gdanska, Gdansk – PL
University Ovidius Constanta – RO
University of Zilina – SK

The next point on the agenda focused on the activity of the Working Groups.

Prof. Iacint Manoliu, Chairman of the Working Group D made an information about the activities of the Group. He presented the state-of-the-art of the answers received to the questionnaire and announced the new deadline for completing the questionnaires (extended till 15 January 2001). The next meeting of the Working Group D was planned on 19-20 January 2001 at Barcelona, hosted by Universitat Politecnica de Catalunya.

For the Working Group E the summary of progress has been presented by Prof. David Lloyd Smith on behalf of Prof. Patrick Holmes. The Working Group had a meeting in Thessaloniki, on 19-21 October 2000. As a result, the WG was divided into three sub-groups with eight to ten colleagues each. The sub-groups are:

1. *Attitudes and Skills of Learning (Students and Academics)*, Chairman Luis Lemos, Coimbra
2. *Methods of Communication*, Chairman Demos Angelides, Thessaloniki
3. *Balance in Engineering Education*, Chairman Eivind Bratteland, Trondheim.

The sub-groups met individually, in order to identify key objectives and to allocate specific tasks to individual members. In a Plenary Session, progress reports were given by each sub-group, to ensure that all members were aware of the routes by which the work was done and to let the Chairman to see where overlaps or omissions may exist.

Overall, the work of the group was progressing well. The Chairman of Working Group E invited as many colleagues as possible to submit examples of innovative teaching so that the extensive work of the teaching staff in developing their courses can be made available to a wider audience. This request was proposed to be placed on the EUCEET Web site as an invitation.

Ms. Colin Kerr presented a short information regarding the activity of the Working Group F, chaired by Mr. François-Gérard Baron. He specified that, due to the special nature of the subject the Working Group F was dealing with, the number of the participants to the Group was rather reduced at the beginning. Prof. Manoliu stressed the necessity to increase the number of the National Reports received and proposed the postponement of the deadline of the submission of the National Reports until the end of January 2001. The next meeting of WG F was planned on 1st of March 2001 in Paris, hosted by ENPC.

In the second session, Prof. Iacint Manoliu made a presentation on the state-of-the-art of the first EUCEET volume "*Inquiries into European Higher Education in Civil Engineering*". All three Working Groups (A, B and C) finished their contributions, which were already sent to Bucharest.

Prof. Iacint Manoliu made a presentation of the position adopted by European engineering education organisations such as SEFI and CESAER toward the "*Bologna Declaration*", followed by comments and discussions.

Prof. Josef Ferreira Lemos briefly introduced the ESOEPE (European Standing Observatory for the Engineering Profession and Education). The first meeting will take place on 27 January 2001 in Darmstadt, following the 3rd European Workshop on Accreditation of Engineering Programmes.

In the third session, Prof. Iacint Manoliu presented to the participants the proposals related to the next EUCEET meetings venues and dates.

Prof. Marie-Ange Cammarota and Prof. Iacint Manoliu proposed to the participants that the EUCEET project, ending at 31 August 2001, to be followed by a 1 - year dissemination period, an expression of interest being already sent to Brussels.

Prof. Iacint Manoliu informed the participants about the preparations underway for the EUCEET-ECCE International Conference "*Challenges to the Civil Engineering profession in Europe at the beginning of the third millennium*" organised by the Technical University of Civil Engineering of Bucharest, to take place on 13-15 July 2001 in Sinaia, Romania. The first Bulletin including call for papers and pre-registration form was sent in early November 2000 by the Coordinator to all partners.

- *The 2nd meeting in the 3rd year of the Steering Committee, Paris, 2 March 2001*

The meeting was organised and hosted by E.N.P.C. Paris and was attended by the following members: Prof. Marie-Ange Cammarota, ENPC Paris, Coordinator; Dr. David Lloyd Smith, Imperial College London, Deputy Coordinator; Prof. Iacint Manoliu, TUCE Bucharest, Secretary General; Prof. Laurie Boswell, City University London; Prof. Jose Manuel Pinto Ferreira Lemos, University of Porto; Prof. Manfred Federau, Engineering College of Odense; Prof. Jose Luis Juan-Aracil, ETSICCP Madrid; Prof. Richard Kastner, INSA Lyon; Prof. Stavros Savidis, Technical University of Berlin; Prof. Efrossini Kalkani, National Technical University of Athens; Mr. Xavier Sanchez-Vila, University Politehnica of Catalunya.

The meeting was also attended by a number of representatives of partner institutions, namely: Prof. Peter Ruge, Technical University of Dresden; Mr. Colin Kerr, Imperial College London; Ms. Gabriela Vila, University Politehnica of Valencia; Prof. Nicoleta Rãdulescu, TUCE Bucharest; Assoc. Prof. Vincentas Stragys, University Vilnius Gediminas; Prof. Antal Lovas, University of Technology and Economics Budapest; Prof. Bruce Misstear, Trinity College Dublin; Prof. Alois Materna, Technical University of Brno; Prof. Vaclav Kuraz, Czech Technical University Prague; Prof. Virgil Breabãn, University "Ovidius" Constantza; Dipl.-Ing. Ralf Reinecke, Technical University Munich.

The ENPC Paris was represented by: Mr. Pierre Veltz, Director of ENPC; Mr. Alain Neveu, Head of Department; Mr. Jean Michel Torrenti, Head of Department; Ms. Adelaide Ferraille.

The first point of the agenda dealt with the financial aspects of the 3rd year of the project. Prof. Cammarota made a very comprehensive presentation regarding the ENPC's proposal on the EUCEET budget for the 3rd year – 2000/2001 and the EC budget proposal. Also she informed the participants that a money transfer to the associated countries will be done immediately after the grant sent by Brussels will reach the ENPC Bank account.

The second point on the agenda focused on the activity of the Working Groups.

Prof. I. Manoliu, chairman of the Working Group D, made an information about the activities of the Group in the period from December 2000 till February 2001. He summarised the meeting on 19 January 2001 hosted by U. P. Barcelona, where a number of 14 people participated, and the Questionnaire on the Master and Doctoral programmes was discussed and amended.

Prof. I. Manoliu informed the audience on the first meeting of the sub-group dealing with continuous professional development which took place on 22 February 2001, hosted by University "Ovidius" Constantza.

The next meeting of the WG D was planned on 3 May 2001 in Trondheim, hosted by the Norwegian University of Science and Technology.

The summary of the activities of the WG F has been presented by Mr. Colin Kerr.

The WG F members met on 1 March 2001, at ENPC, Paris, discussing the answers to the questionnaire with 19 questions prepared and sent to a great number of institutions. Mr. C. Kerr told the participants that more details will be given by Mr. F. G. Baron, during the second session of the Steering Committee meeting.

The third point on the agenda has been represented by the presentation of the first EUCEET volume, entitled "*Inquiries into European Higher Education in Civil Engineering*".

Prof. I. Manoliu, one of the two editors (the second one being Assoc. Prof. T. Bugnariu) had the pleasure to offer the very first 15 copies to the representatives of the partner institutions attending the meeting. After the distribution of the volume, some comments, questions, proposals followed.

It was decided that each academic institution partner in the project will receive 3 volumes, from which one to be given to the Library. Non-academic institutions partners in the project will receive two volumes (one for the Library). In addition, each partner will be invited to send to Prof. M A Cammarota a list of institutions and people to which the volume should be sent. Each volume will be joined by a personalized letter signed by the EUCEET Coordinator. The contact persons of EUCEET partner institution could also add a letter, if they wish so. As a rule, the volume should reach all institutions outside EUCEET involved in the surveys undertaken by the WGs A, B and C.

The second session has been opened by the comprehensive presentation of the content of the WG F report made by the chairman of this Working Group, Mr. F. G. Baron: introduction; summary of the answers to the Questionnaire, for each country; conclusions.

The next WG F meeting was planned to take place on 11-12 May at Porto, together with the meeting of the ECCE Task Force on Education.

The next point on the agenda was the presentation made by Prof. I. Manoliu on the state-of-the art of the preparations for EUCEET-ECCE International Conference "*Challenges to the Civil Engineering Profession in Europe at the Beginning on the New Millennium*" (13-15 July) included in the Third EUCEET

General Assembly (13-17 July 2001): the programme of the period from 13 to 17 July 2001 and the 10 topics of the 10 plenary sessions. Some financial matters have been discussed, too.

The next point on the agenda was the presentation of the EUCEET Full Application for the Dissemination Year, submitted to the Commission in Brussels on 28 February 2001. Prof. Marie-Ange Cammarota explained the general rules of this kind of application and, accordingly, some financial aspects. The new application has a total number of 87 partner institutions, all the former partners and a number of 7 new partners.

Prof. I. Manoliu described the main activities planned, including meetings, Steering Committee meetings, Working Group meetings, EUCEET Regional Fora and the publications.

The last point on the agenda focused on the preparation of the pre-proposal for a EUCEET II project, due to be sent to Brussels by 1st November 2001 as part of the Institutional Contract of the ENPC.

Prof. I. Manoliu asked all participants to contribute by the time of the General Assembly in Sinaia with proposals and ideas, concerning the content of the new project EUCEET II.

- *The 3rd meeting in the 3rd year of the Steering Committee, Trondheim, 4 May 2001*

The meeting was organised and hosted by The Norwegian University of Science and Technology and was attended by the following members of the Steering Committee: Prof. Marie-Ange Cammarota, ENPC Paris, Coordinator; Prof. Iacint Manoliu, TUCE Bucharest, Secretary General; Prof. Laurie Boswell, City University London; Prof. Manfred Federau, Engineering College of Odense; Prof. Jose Luis Juan-Aracil, ETSICCP Madrid; Prof. Richard Kastner, INSA Lyon; Prof. Josef Machacek, Czech TU Prague and AECEF; Mr. Xavier Sanchez-Vila, University Politecnica of Catalunya.

The meeting was also attended by a number of representatives of partner institutions, namely: Assoc. Prof. Tudor Bugnariu, TUCE Bucharest; Prof. Josef Dicky, STU Bratislava; Prof. Roger Frank, ENPC Paris; Prof. Stanislaw Majeski, Silesian University of Technology Gliwice; Prof. Wojciech Gilewski, University of Technology of Warsaw; Prof. Ryszard Kowalczyk, University of Beira Interior; Prof. Andrzej Lapko, Bialystok Technical University; Prof. Jean-Paul Mizzi, ENTPE Vaulx en Velin; Prof. Nicoleta Radulescu, TUCE Bucharest; Prof. Paulica Raileanu, TU Gh. Asachi Iasi.

The Norwegian University of Science and Technology Trondheim was represented by Prof. Eivind Bratteland.

The first point of the agenda dealt with the contractual financial aspects of the 3rd year of the project. Prof. M. A. Cammarota made a very comprehensive presentation. It has been emphasised that the cofinancing percentage is of 80% for the EUR 18 countries, the maximum SOCRATES grant allocated being of 210.000 EURO.

The maximum SOCRATES grant allocated for all associated countries is of 59.560 EURO. The allocation for the 3rd year of the project has been reduced in comparison to the 2nd year, although the total number of eligible partners increased. In order to improve the quota of the associated countries, ENPC sent to Brussels a proposal for a redistribution of the total amount of grant between the EUR 18 and associated countries.

The EUCEET activities undertaken between September 2000 and March 2001 as well as the expenditures related to travel and subsistence for the participants belonging to EUR 18 group were summarised. At the end, Prof. M. A. Cammarota presented the activities to take place until the end of the contractual period of the 3rd year and an estimation of the expenditures related to the mobilities previewed.

The second point on the agenda focused on the activity of the Working Groups. Prof. Iacint Manoliu, chairman of the Working Group D, informed about the activities of the Group in the period from January – May 2001. According to the conclusions of the WG D meeting on January 2001 in Barcelona, several amendments have been brought to the Questionnaire on postgraduate programmes, and a new form of the Questionnaire has been sent to all partners institutions. During the meeting which took place on May 3rd 2001 in Trondheim, the 31 answers received have been presented and commented. The main conclusion of this meeting was the necessity to intensify the efforts in order to increase the number of the answers, in first place from EUCEET partners. The next and last meeting of the WG D was decided to take place in July 2001 in Sinaia, Romania.

A short presentation of the activity of the Working Group E was made by Prof. E. Bratteland on behalf of Prof. P. Holmes, the chairman of this Working Group. The last meeting of WG E took place in October 2000 in Thessaloniki. There were on that occasion separate meetings of the three sub-groups of the WG E (dealing with “Attitudes and Skills”, ‘New Methods of Communication” and “Balance in Civil Engineering Degrees/Diplomas”) as well as meetings of the whole group.

The meeting of the WG E expected to take place on 3rd May at Trondheim was cancelled and the date and venue of another meeting have not been established.

On behalf of F.G. Baron, chairman of the WG F, Prof. L. Boswell informed the audience that the next meeting of this WG was planned to take place on 11th May in Porto, together with the ECCE Task Force on Education meeting.

The third point on the agenda focused on the 3rd EUCEET General Assembly to take place on 13-17 July 2001 in Sinaia, Romania, incorporating the EUCEET - ECCE Conference “*Challenges to the Civil Engineering Profession in Europe at the Beginning of the Third Millennium*”. Prof. I. Manoliu presented the Technical programme and the activities time-table of the EUCEET events.

The Bulletin 2 and the Registration Form was distributed to all participants at the Steering Committee meeting. A total number of about 400 copies of the Bulletin had been sent not only to EUCEET partner institutions but also to other persons and institutions interested in the EUCEET events.

Prof. Manoliu showed that for a succesful conclusion of the project is essential to have a very large participation at the General Assembly and Conference in Sinaia. As resulted from the presentation of the budget for the 3rd year made by Prof. Cammarota, it is possible to have at least two participants from EUR-18 and at least one participant from the associated countries, to attend the Sinaia events.

• *The EUCEET Third General Assembly and the EUCEET-ECCE International Conference "Challenges to the Civil Engineering Profession in Europe at the Beginning of the Third Millennium", Sinaia, Romania, 13-17 July 2001*

The EUCEET Third General Assembly took place on 13-17 July 2001 in Sinaia, organized by the Technical University of Civil Engineering of Bucharest, Romania.

In the programme of the General Assembly was included the International Conference "*Challenges to the Civil Engineering Profession in Europe at the Beginning of the Third Millennium*", on 13-15 July 2001, under the auspices of EUCEET and of the European Council of Civil Engineers – ECCE.

ECCE 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. The EU institutions now recognise ECCE as the single voice for the profession. ECCE members are the professional Civil Engineering associations in individual 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 Thematic Network.

The General Assembly and the Conference were attended by 122 participants from Belgium (3), Bulgaria (3), Czech Republic (5), Denmark (2), Estonia (1), Finland (3), France (7), Germany (4), Greece (2), Hungary (3), Ireland (1), Italy (2), Latvia (1), Lithuania (1), Norway (1), Poland (3), Portugal (8), Slovak Republic (2), Slovenia (2), Spain (5), United Kingdom (7) and Romania (30).

Academic institutions partners in the EUCEET consortium and represented at the events in Sinaia were: University of Liège, Université Catholique de Louvain, Louvain-le-Neuve, Katholieke Universiteit Leuven, Sofia University of Architecture, Civil Engineering and Geodesy, Czech Technical University Prague, University of Pardubice, Danish Technical University Lingby, Technical University Tallin, Helsinki University of Technology, Ecole Nationale des Ponts et Chaussées, INSA Lyon, ENTPE Lyon, Technical University Berlin, Technical University Dresden, Aristotle University of Thessaloniki, Budapest University of Technology and Economics, University of Dublin, Trinity College, Technical University Riga, Vilnius Gediminas Technical University, Norwegian University of Science and Technology Trondheim, Silesian Technical University

Gliwice, Technical University Warsaw, Technical University Bialystok, Instituto Superior Tecnico Lisbon, University of Porto, University of Coimbra, University of Beira Interior, Slovak Technical University Bratislava, Technical University Kosice, University of Ljubljana, University of Maribor, Universidad Politecnica Madrid, Universitat Politecnica de Catalunya Barcelona, Universidad Politecnica Valencia, City University London, Imperial College London, University of Wales Cardiff, University of Nottingham, Technical University Iaşi, Technical University Cluj-Napoca, Technical University Timişoara, University "Ovidius" Constanta and Technical University of Civil Engineering of Bucharest.

The General Assembly and the Conference were open on Friday 13 July 2001 by Prof. Iacint Manoliu from the Technical University of Civil Engineering of Bucharest, Secretary General of EUCEET Steering Committee and Chairman of the Organising Committee.

Welcome addresses were then presented by: Prof. Petre Patrut, Rector of the Technical University of Civil Engineering Bucharest, Dr. Traian Ispas, Vice-President of the Union of Associations of Civil Engineers of Romania, Prof. Antonio Adao da Fonseca, President of the European Council of Civil Engineers, Prof. Radu Damian, State Secretary at the Ministry of Education and Research, Ion Stanescu, Director General at the Ministry of Public Works, Transportation and Housing.

In the programme of the Conference were included four Key-note lectures:

- Antonio Adao da Fonseca, ECCE President, "*The European Civil Engineer of the 21st Century*"
- François-Gerard Baron, ECCE Vice-President, EUCEET Working Group F Chairman, "*Challenge for the Civil Engineer in 2001: a World to Serve*"
- Alfredo Soeiro, President of the International Association for Continuing Engineering Education, "*Latest Development in Continuing Engineering Education*"
- John Whitwell, ECCE Secretary General, "*WTO GATS Registration & Mutual Recognition of Engineers*"

Sessions of the Conference comprised General Reports of various EUCEET Working Groups, theme lectures and the presentation of a number of selected papers.

In what follows, a brief presentation of the content of the sessions is given.

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

Chairperson: Jose-Luis Juan-Aracil, Universidad Politecnica Madrid

Theme lecture: Derek Pollock, Halcrow Group Ltd, UK

"*Professional Pressures in the Recruitment and Deployment of Civil Engineering Expertise in Europe; a Consultancy View*"

General Report of the EUCEET Working Group F presented by François-Gerard Baron, EUCEET Working Group F Chairman

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

Chairperson: Alois Materna, The Czech Chamber of Certified Engineers and Technicians Engaged in Construction

Theme lecture: Horea Sandi, Institute of Geodynamics "Sabba Stefanescu" of the Romanian Academy

"*Education of Civil Engineers in View of Disaster Prevention.The Case of Earthquakes in Romania*"

Presentation of 3 selected papers and discussions

Session II: Continuous Professional Development in Civil Engineering

Chairperson: Josef Dicky, Technical University Bratislava

Theme lecture: Amaury Legait, Roger Frank, Ecole Nationale des Ponts et Chaussées

"*Enhancing the role of the universities in continuing engineering education activities: A challenge at the beginning of the 21st century"*

Presentation of 2 selected papers and discussions

Session IIIa: Trends in European Civil Engineering Education

Chairperson: Stanislaw Majewski, Silesian University of Technology

General Report of the EUCEET Working Group A, presented by Iacint Manoliu, Technical University of Civil Engineering Bucharest, Chairman of the Working Group A.

Theme lecture: Guenther Heitmann, T.U. Berlin

"*The Implementation and Accreditation of Bachelor/Master Degree Courses in Germany*"

Theme lecture: Diego Lo Presti, Politecnico di Torino.

"*Higher education in Italy: the Transition Phase from Old to New System*"

Presentation of 2 selected papers and discussions

Session IIIb: Trends in European Civil Engineering Education

Chairperson: Vaclav Kuraz, Czech Technical University Prague

Theme lecture: Carsten Ahrens, University of Applied Sciences Oldenburg
"*Modularizing European Civil Engineering Curricula*"

Presentation of 2 selected papers and discussions

Session IV: Synergies between University, Research, Industry and Public Authorities in the Construction Sector of Europe

Chairperson: Pedro Seco e Pinto, Laboratorio Nacional de Engenharia Civil Lisbon
General Report of the EUCEET Working Group C, presented by Colin Kerr, Imperial College London

Theme lecture: Laurie Boswell, City University London
"*What European Universities Can Do for the Construction Sector*"

Presentation of 2 selected papers and discussions

Session V: Accreditation and Professional Recognition in Civil Engineering

Chairperson: Mircea Mihailescu, The Union of Associations of Civil Engineers of Romania

General Report of the EUCEET Working Group B, presented by Ferreira Lemos, University of Porto, Chairman of the Working Group B.

Theme lecture: Giuliano Augusti, University "La Sapienza" Roma
"*Facilitating Recognition and Mobility in European Engineering Education*"

Presentation of 2 selected papers and discussions

The EUCEET-ECCE Conference concluded on 15th July 2001 at noon. Activities of the General Assembly resumed on Monday 16 and ended on Tuesday 17 July 2001 at noon with 3 more sessions.

Session VIa: Innovation in Teaching and Learning in Civil Engineering Education

Chairman: Dan Stematiu, Technical University of Civil Engineering Bucharest

General Reports presented by the Chairmen of the Subgroups of the EUCEET Working Group E

- Eivind Bratteland, Norwegian University of Science and Technology
"Balance in Engineering Education"

- Luis Lemos, University of Coimbra
"Attitudes and Skills of Learning (Students and Academics)"

- Demos Angelides, University of Thessaloniki
"Methods of Communication"

Session VIb: Innovation in Teaching and Learning in Civil Engineering Education

Chairman: Choo Ban Seng, Nottingham University

Five papers prepared by the members of the Working Group E were presented, followed by discussions.

Session VII: Postgraduate Programmes and Continuous Professional Development in European Civil Engineering Education

Chairman: Laur Toomas, Tallin Technical University

General Report of the EUCEET Working Group D, presented by Iacint Manoliu and Tudor Bugnariu, Technical University of Civil Engineering Bucharest

Two papers prepared by the members of the Working Group D were presented, followed by discussions.

The last activity in the programme of the General Assembly was a Round table which took place on Tuesday, July 17, 2001, entitled: **EUCEET I Conclusions and Perspectives for Future Cooperation**. As moderator acted Prof. Iacint Manoliu. Participated: Prof. Jose-Luis Aracil, Universidad Politecnica de Madrid, Prof. Laurie Boswell, City University London, Dr. David Lloyd Smith, Imperial College London, Prof. Josef Machacek, Czech Technical University Prague, Prof. Giuliano Augusti, University "La Sapienza" Roma, Prof. Guenther Heitmann, T.U. Berlin.

Themes to form the objectives of a new project, EUCEET II, in the period 2002-2005 were proposed and discussed, as a basis for the pre-proposal to be included in the IC of ENPC, to be sent to the EC by 1st November 2001. Partners unanimously agreed to build the new project EUCEET II and to seek support for its implementation.

2. EUCEET in the dissemination year (2001/2002)

The main objective of the project EUCEET is *to enhance the cooperation between universities, faculties and departments of civil engineering in Europe, with the involvement of academic and professional associations, in order to contribute to the development of civil engineering education and to increase its quality and effectiveness*.

For the *Dissemination project* the main objective was, of course, the same. The most relevant specific objectives for the *Dissemination project*, were:

- organisation of three EUCEET Regional Fora,
- organisation of meetings of the Working Groups E and F, in order to finalise the reports,
- publication of two new EUCEET Volumes,
- preparation of two CD-ROM,
- publication of a pamphlet on EUCEET,
- updating the Web site of EUCEET,
- making EUCEET objectives and outcomes known to the academic and professional communities by presentations in Conferences, Symposia, Workshops etc,
- inserting papers on EUCEET in SEFI and AECEF Newsletters.

It can be stated that the objectives were *fully achieved*.

Of particular importance were the three *EUCEET Regional Fora*. Open to project partners and to other institutions, with emphasis on academic and non-academic institutions from the host country, each Forum was meant as a true *Conference on civil engineering education*, to discuss matters concerning civil engineering education in Europe in the light of the EUCEET findings and of the transformations occurring in the European area of higher education.

The input of the Network consisted in a general presentation of the project prepared jointly by the Coordinator and by the Secretary General of the Steering Committee and by 6 brief reports on the outcomes of the Working Groups. It was left to the local organizer to choose the kind and the number of other contributions, in order to have the programme as complete and efficient as possible. This approach proved to be a very good one, the three Fora being in fact events with distinctive and interesting features.

The Madrid Forum (9-10 May 2002), was attended by about 200 people: EUCEET delegates, representatives of all nine "*Escuelas*" offering civil engineering education programmes of long duration in Spain and a number of distinguished representatives of the construction industry and of public authorities in Spain.

The Round-table with the Directors of the "*Escuelas*" gave the opportunity of a comprehensive exchange of views, with the participation of the EUCEET partners, on the challenges posed to the higher education institutions as a results of the Bologna process and on the ways to meet these challenges.

The second Forum, in Gliwice (13-15 June 2002) put together the EUCEET people and the representatives of all institutions offering civil engineering education in Poland. This was possible because the EUCEET Forum was preceded by the *Annual Conference of the Polish Civil Engineering Faculties*. By this way, EUCEET people could learn about problems to which are confronted their colleagues from Poland. At the same time, the Polish community of civil engineering teachers learned about the outcomes of EUCEET and about the civil engineering education in U.K., Germany, Italy, Baltic and Central-European countries, through the Reports presented by the EUCEET delegates from these countries.

At the third Forum, in Münich (6 September 2002), the dialogue *university – professional world* was again very active. Each of the brief reports on the main outcomes of the six EUCEET Working Groups was matched by one or two presentations based on the German experience. Thus, the EUCEET delegates could learn about the position of the *Association of the Civil Engineering Faculties in Germany* about the changes occurring in the German higher education system as a result of the *frame law* from 1998, about the way in which continuing education activities are organised, about the views of the construction industry - both contractors and consultants - on civil engineering education, about the educational and teaching approaches promoted at the host university a.s.o.

In conclusion, by the excellent organisation insured by the three host universities (Universidad Politecnica Madrid – ETSICCP, Silesian University of Technology Gliwice and Technische Universität München), by the good attendance (particularly in Madrid), by their impact on civil engineering schools (particularly in Madrid and Gliwice), by the involvement of the industry and of the professional world (in Madrid and Münich) and, above all, by creating opportunities for vivid and serious debates on issues of vital importance for the civil engineering education in Europe, the three EUCEET Fora met entirely the expectations.

In a special section of this volume, devoted to the three EUCEET Fora, the programme and additional informations on the events which took place in Madrid, Gliwice and Münich, are given.

The publication of *two new* EUCEET *volumes* represents another major contribution to the dissemination of the outcomes of the Network. Both volumes keep the title of the one with which the serie was inaugurated: "*Inquiries into European higher education in civil engineering*".

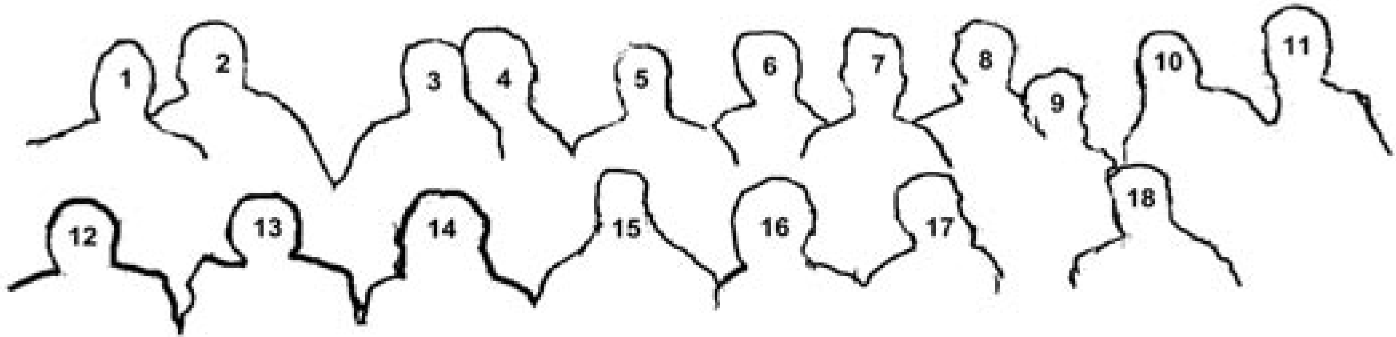
The third volume is the present one.

The fourth volume contains 22 National Reports on civil engineering education in countries represented in the Network. A wealth of information about civil engineering education in these countries were obtained through the survey conducted by the Working Group A (Curricula in Civil Engineering Education at Undergraduate level) and included in the Report of the WG A which was part of the 1st EUCEET Volume. However, in the time elapsed since launching of the survey and collecting the answers from more than 100 higher education institutions, changes occurred in several countries, triggered in most part by the *Bologna process*. It became necessary to up-date the information and to present it under the form of National Reports.

The volume opens with a general presentation on the civil engineering programmes in Europe, with emphasis on the impact of the *Bologna process*. In the volume is also included a CD containing the full data collected by the surveys conducted in 1999 and 2000, related to the organisation of civil engineering education at undergraduate level in Europe, to the curricula structure for the first civil engineering degree and to the postgraduate programmes in civil engineering education.

Since the first two EUCEET Volumes were already distributed to the partners and to other interested institutions and persons, a very efficient way of disseminating EUCEET outcomes was to edit a CD-ROM with the content of those volumes. The 1st volume contained a presentation of EUCEET activities in the first two years (1998/1999 and 1999/2000), a comprehensive report on "*Civil engineering in the context of the European Higher Education area – the role of EUCEET*" and the Reports of the Working Groups A, B and C. The Second EUCEET volume contained the Proceedings of the EUCEET – ECCE Conference "*Challenges to the civil engineering profession in Europe at the beginning of the third millennium*", included in the programme of the third EUCEET General Assembly which took place in Sinaia, Romania, on 13-17 July 2001.


WIELICZKA 2002



WIELICZKA 2002

On the day following the closure of the EUCEET Forum in Gliwice, some of the participants enjoyed a very nice excursion to Cracow and surroundings, organized by the Silesian University of Technology. The programme included a visit of the famous Royal Salt Mine in Wieliczka, registered on UNESCO's First World List of Cultural and Natural Heritage.

A group picture was taken in the Chapel of St. Kinga lying 101 metres below ground level.

1. Jacques Lerau (INSA Toulouse), 2. Alois Materna (T.U. Ostrava), 3. Jozef Dicky (S.T.U. Bratislava), 4. Carsten Ahrens (F.H. Oldenburg), 5. Grzegorz Wandzik (S.U.T. Gliwice), 6. Leszek Szojda (S.U.T. Gliwice), 7. David Lloyd-Smith (Imperial Collge London), 8. Josef Machacek (C.T.U. Prague), 9. Colin Kerr (Imperial College London), 10. Stefan Bergmann (T.U. Berlin), 11. Juris Smirnovs (Riga T.U.), 12. Manfred Federau (Engineering College Odense), 13. Stanislaw Majewski (S.U.T. Gliwice), 14. Nicoleta Radulescu (T.U.C.E. Bucharest), 15. Iacint Manoliu (T.U.C.E. Bucharest), 16. Marie-Ange Cammarota (E.N.P.C. Paris), 17. Jose Juan-Aracil (Universidad Politecnica de Madrid), 18. Ryszard Kowalczyk (University of Beira Interior, Covilha)

The CD-ROM with the two volumes was distributed to the participants of the three EUCEET Fora and of numerous other engineering Conferences attended by EUCEET representatives, which took place in 2001/2002, such as: *29th SEFI Annual Conference*, Copenhagen, 12-14 September 2001; *Second International Conference on soil – structure interaction in urban civil engineering*, Zurich, 7-8 March 2002; *International Conference on Education in Engineering and Technology*, Santos, 19-21 March 2002; *12th Danube-European Conference on Soil Mechanics and Geotechnical Engineering*, Passau, 27-29 May 2002; *35th ECCE Meeting*, Helsinki, 7-8 June 2002; *30th SEFI Annual Conference*, Florence, 8-11 September 2002; *36th ECCE Meeting*, Athens, 13-14 September 2002; *4th AECEF International Symposium "Environmental aspects in civil engineering education*", Porto, 18-20 September 2002; *ASEE-SEFI-TUB International Colloquium "Global changes in engineering education*", Berlin, 30 September–4 October 2002.

During the dissemination year the web page of EUCEET (http://www.euceet.utcb.ro) was continuously updated with the developments taking place in the Project, representing also a very powerful tool for the dissemination of information about the project and project outcomes.

One of the most effective way of making the EUCEET aims and outcomes known to a wider audience, was represented by the presentations made by the Secretary General of the Steering Committee, Prof. Iacint Manoliu, from the Technical University of Civil Engineering of Bucharest, at various conferences, symposia, meetings such as:

- The National Conference of Structural Engineers of Slovenia, Bled, 18 October 2001
- The 34th ECCE meeting, Ljubljana, 19 October 2001
- The "International Week" at the Fachhochschule Oldenburg, 22-25 October 2001
- The International Conference on Engineering and Technology Education, Santos, 19-21 March 2002
- The 35th ECCE meeting, Helsinki, 7-8 June 2002
- The Annual SEFI Conference, Florence, 8-11 September 2002
- The 36th ECCE meeting, Athens, 13-14 September 2002
- The 4th AECEF General Assembly, Porto, 19 September
- The ASEE-SEFI-TUB International Colloquium "Global changes in engineering education", Berlin, 30 September - 4 October 2002.

At the Conference in Santos, Prof. Manoliu presented a paper "*Networking in engineering education – the European experience*" which is inserted in the proceedings of the Conference. Also, at the SEFI Conference in Florence, Prof. Manoliu presented the paper "*EUCEET and the Renaissance civil engineer*" which is in the proceedings. At the ASEE-SEFI-TUB International Colloquium in Berlin, Prof. Manoliu participated at the poster session with a poster describing the main EUCEET outcomes and the objectives of EUCEET II.

In the No. 2/2001 issue of the AECEF Newsletter, periodical of the Association of European Civil Engineering Faculties, a large section was devoted to EUCEET. Also, in the winter 2001/2002 issue of SEFI News (No. 89), a paper entitled "*The third EUCEET General Assembly and the EUCEET-ECCE Conference*", written by Prof. Iacint Manoliu, was inserted.

The success of the activities undertaken by EUCEET during the dissemination year is closely related to the organisational approach and structure developed within the partnership to manage the project. A decisive role was played by the Steering Committee which defined clearly the outputs to be expected in the dissemination year and took care to provide the means and ways required for their accomplishment. It is important to note that the three organisers of the EUCEET Fora, Prof. J.L. Aracil from the Universidad Politecnica – ETSICCP Madrid, Prof. S. Majewski from the Silesian University of Technology and Dipl.-Ing. R. Reinecke from Technische Universität München were members of the Steering Committee.

An important feature of the TNP EUCEET is the good representation of the professional world in the consortium of partners and the active involvement of the professional associations in various activities. This feature was stressed again all along the dissemination year. As stated before, the construction industry and the professional associations were well represented at the EUCEET Fora in Madrid and Munich. ECCE (European Council of Civil Engineers) which had its former President, M. François-Gerard Baron as Chairman of the Working Group F "*Demands of the economic and professional environments in respect to civil engineering education*" and organised jointly with EUCEET the EUCEET-ECCE Conference "*Challenges to the Civil Engineering profession in Europe at the beginning of the third millennium*" (Sinaia, Romania, 13-15 July 2001) included in the agenda of the 34th, 35th and 36th Meetings in Ljubljana , Helsinki and, respectively, Athens, a special item dedicated to EUCEET, under the auspices of the ECCE Task Force on Education.

An important outcome of the Dissemination Project should be considered the preparation of a *Pre-proposal* for a new project EUCEET II and, after its acceptance by the EC, the preparation of a Full proposal for EUCEET II under Erasmus 3, sent to Brussels by 1st March 2002.

The application was approved by the EC for an eligibility period from 01/10/2002 to 30/09/2005.

PART TWO

REPORT OF THE
WORKING GROUP D

Postgraduate Programmes and Continuing Professional Development in Civil Engineering

Synthesis of Activities Undertaken by the Working Group D

Postgraduate Programmes and Continuing Professional Development in Civil Engineering Education

Iacint MANOLIU
Tudor BUGNARIU

Technical University of Civil Engineering Bucharest (RO)

SYNTHESIS OF ACTIVITIES UNDERTAKEN BY THE WORKING GROUP D

1. Objectives

The main objective of the Working Group D was to collect data about different forms of postgraduate education in civil engineering education, such as Master and Master type programmes and Doctoral programmes.

Another objective was to assess the involvement of higher education institutions in activities of continuing education in civil engineering.

2. Working methods

In order to accomplish the objectives mentioned before, the Working Group decided to conduct surveys based on questionnaires and to organise meetings and workshops to discuss matters related to the theme assigned.

3. Meetings and workshops

The first meeting of the Working Group D took place on the 29th May 2000 in Odense.

On 13th June 2000, the Working Group organised in Sinaia, Romania, a Workshop on *Postgraduate (master and doctoral) programmes in Geotechnical Engineering Education in Europe*, which was included in the programme of the 1st International Conference on Geotechnical Engineering Education and Training.

During the third year of the project (01.10.2000-30.09.2001), the Working Group D organised the following meetings:

- 19 January 2001, Univeristat Politecnica de Catalunya, Barcelona, ES, Meeting of the Working Group D:
  - discussions, amendments and state-of-the-art of the answers to the questionnaire;
  - discussion on a new questionnaire regarding Continuing Education in Civil Engineering;
  - presentation on "*Graduate studies and research in civil engineering at the Civil Engineering School of Barcelona*".

- 22 February 2001, University „Ovidius” Constantza, RO, Meeting of Working Group D – subgroup on *Continuous Professional Development*:
  - presentation and discussion on the new questionnaire regarding Continuing Education in Civil Engineering;
  - participation to the Workshop “*Enhancing the role of Universities in continuing engineering education activities - a challenge at the beginning of the 21st century*”.

- 3 May 2001, Norwegian University of Science and Technology, Trondheim, NO, Meeting of the Working Group D:
  - state-of-the-art of received answers to EUCEET WG D questionnaires;
  - brief evaluation of the received answers and discussions;
  - presentation of the doctoral studies in Lyon, France;
  - presentation of doctoral programmes in Civil Engineering at the Norwegian University of Science and Technology, Trondheim

- On the 17th July 2001, the Working Group D organised in Sinaia under the frame of the Session VII of the EUCEET 3rd General Assembly a workshop entitled „*Postgraduate programmes and continuous professional development in European civil engineering education*”.

4. Membership of theWorking Group D

Chairman: Professor Iacint Manoliu, Technical University of Civil Engineering of Bucharest, Romania

Deputy Chairman: Associate Professor Tudor Bugnariu, Technical University of Civil Engineering of Bucharest, Romania

Members: Professor Ulvi Arslan, Darmstadt University of Technology, Germany.
Professor Franco Angotti, University of Florence, Italy.
Professor George Mihail Barsan, Technical University of Cluj-Napoca, Romania.
Professor Carlos Agelet de Saracibar Bosch, ETS Ingenieros de Caminos, Canales y Puertos, Barcelona, Spain.
Professor Jozef Dický, Slovak University of Technology, Bratislava, Slovakia.
Professor Roger Frank, ENPC Paris, France.
Professor Efrossini Kalkani, National Technical University of Athens, Greece.
Professor Richard Kastner, INSA Lyon, France.
Professor Tiit Koppel, Tallinn Technical University, Estonia.

Professor Ryszard Kowalczyk, University of Beira Interior, Covilha, Portugal.
Professor Vaclav Kuraz, CTU in Prague, Czech Republic.
Professor Andrzej Łapko, Bialystok Technical University, Poland.
Professor Pericles Latinopulos, Aristotle University of Thessaloniki, Greece.
Professor Luís Lemos, University of Coimbra, Portugal.
Professor David Lloyd-Smith, Imperial College London, United Kingdom.
Professor Josef Machacek, CTU in Prague, Czech Republic.
Professor Stanisław Majewski, Silesian University of Technology, Gliwice, Poland.
Professor Pedro Seco e Pinto, Laboratorio Nacional de Engenharia Civil Lisbon, Portugal.
Professor Diego Lo Presti, Politecnico di Torino, Italy.
Professor Paulica Raileanu, University “Gh. Asachi” Iasi, Romania.
Dr. Vaidotas Sapalas, Vilnius Gediminas Technical University, Lithuania.
Professor Juris Smirnovs, Riga Technical University, Latvia.
Professor Jorgen Steenfeld, Danish Technical University, Lyngby, Denmark.
Professor Ivan Totev, University of Architecture, Civil Engineering and Geodesy, Sofia, Bulgaria.
Dr. Aleksandar Traikov, University of Architecture, Civil Engineering and Geodesy, Sofia, Bulgaria.
Professor Povilas Vainiūnas, Vilnius Gediminas Technical University, Lithuania.

POSTGRADUATE PROGRAMMES AND CONTINUING PROFESSIONAL DEVELOPMENT IN CIVIL ENGINEERING EDUCATION

1. Introduction

The main objective of the theme assigned to the WG D was to investigate thoroughly forms of postgraduate education in civil engineering education, in first place programmes such as M.Sc., currently present in the offer of institutions from U.K. and Ireland but also in the offer of a number of institutions having the "*continental*" type of engineering education, or as DEA (in France). Also, doctoral programmes were considered in the investigation. A distinct team of the WG D was involved in the matter of continuing education and training in the construction industry of Europe.

The activities of the Working Group D began in May 2000, alongside with the General Assembly of EUCEET in Odense, when the first meeting of its members took place. The main topics of the activities of Working Group D were dedicated to the postgraduate studies in Civil Engineering in Europe, more precisely the Master or Master Type programmes, the Doctoral programmes and the Continuing Education. From the very first meeting of WG D in Odense, the main objectives, working system and responsibilities were decided. Because of the natural continuation of the activities of Working Group A, concerning the Undergraduate Civil Engineering Education, most of the members of WG D and partner institution representatives were the same.

As for the previous stage of analysis concerning Curricula in Civil Engineering Education in Europe at Undergraduate Level (WG A), the main activity of WG D was meant to prepare, send and receive answers to dedicated questionnaires, followed by the results' interpretation.

The first form of the WG D questionnaire dealing with Master or Master Type programmes and the Doctoral programmes was prepared by Prof. Iacint Manoliu, chairman of the WG D, having as a model the questinnaire used previously for a similar purpose in the TNP EUPEN (European Physics Education Network), coordinated by Prof. Henrik Ferdinande (University Gent). The questionnaire was presented at the first meeting in Odense. After discussions and amendments, the questionnaire was then sent to all country representatives in order to be disseminated to all partners and non-partners institutions. After an initial set of received answers, the members of the Working Group D met in Barcelona in February 2001, in order to discuss and analyse the returns. As a result, some necessary amendments where drawn-out and a revised form of the questionnaire was proposed. The second form of the questionnaire was sent again to all partner institution.

Unfortunately, not all-previous respondents updated their answers, thus some of the completed questionnaires remained in the initial form.

The WG D questionnaire is divided in two main and quite similar parts: the first one dedicated to the Master or Master Type programmes and the second one, dedicated to Doctoral programmes (in consequence, the respondents completed only that part corresponding to the type of programme offered by their institution). The main topics of the questionnaire for both parts are the following ones:

- general information on the respondent;
- type of programme, duration of studies, international dimension, etc;
- admission procedure and finance;
- activities during postgraduate studies;
- awarding of the postgraduate degree;
- statistics on recent graduates.

The final form of the WG D questionnaire is listed in the annex. The questionnaire was submitted to the EUCEET institutions during the academic year 2000/2001, answers generally reflecting that specific period.

Regarding the number of received answers, one could notice a dropdown of the enthusiasm of respondents, partner or non-partner institutions, as against to the questionnaire regarding the undergraduate civil engineering education (WG A). Thus, a total of 37 answers were received from 20 European countries, out of these 27 offering Master or Master type programmes and 36 offering Doctoral programmes. Unfortunately, not only the number of answers was low, but also most of the countries are represented by a single answer. A detailed list of respondent countries/institutions is presented in the table below (1). The returns covering 20 countries and the number of returns per country are shown in figure 1 (MP abreviation for Master programmes and DP abreviation for Doctoral programmes).

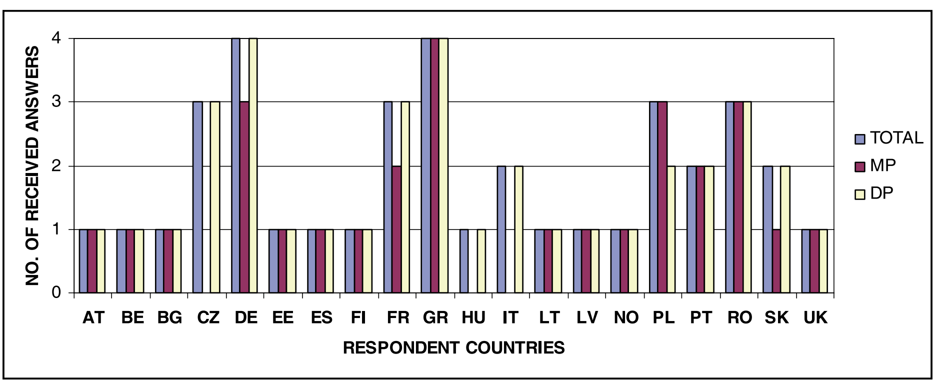


Figure 1. Number of answers per country (Master and Doctoral Programmes)

Table 1. List of received answers

No.	COUNTRY - CITY	INSTITUTION
1	AT - Vienna	Vienna University of Technology
2	BE - Liege	Liege University
3	BG - Sofia	University of Architecture, Civil Engineering and Geodesy
4	CZ - Brno	Brno University of Technology
5	CZ - Pardubice	University of Pardubice
6	CZ - Prague	CTU in Prague
7	DE - Berlin	Technical University of Berlin
8	DE - Darmstadt	Darmstadt University of Technology
9	DE - Dresden	Dresden University of Technology
10	DE - Hamburg	Technical University Hamburg
11	EE - Tallinn	Tallinn Technical University
12	ES - Barcelona	ETS Ingenieros de Caminos, Canales y Puertos
13	FI - Helsinki	Helsinki University of Technology
14	FR - Lyon	Ecole Nationale des Travaux Publics de l'Etat
15	FR - Lyon	INSA
16	FR - Paris	ENPC
17	GR - Athens	National Technical University of Athens
18	GR - Patras	University of Patras
19	GR - Thessaloniki	Aristotle University of Thessaloniki
20	GR - Xanthi	Democritus University of Thrace
21	HU - Budapest	Budapest University of Technology and Economics
22	IT - Firenze	University of Florence
23	IT - Milano	Politecnico di Milano
24	LT - Vilnius	Vilnius Gediminas Technical University
25	LV - Riga	Riga Technical University
26	NO - Trondheim	Norwegian University of Science and Technology
27	PL - Bialistock	Bialystok Technical University
28	PL - Gliwice	Silesian University of Technology
29	PL - Warsaw	Warsaw University of Technology
30	PT - Covilha	University of Beira Interior
31	PT - Coimbra	University of Coimbra
32	RO - Bucharest	Technical University of Civil Engineering
33	RO - Cluj	Technical University of Cluj-Napoca
34	RO - Iasi	Faculty of Civil Engineering and Architecture
35	SK - Bratislava	Slovak University of Technology
36	SK - Zilina	University of Žilina
37	UK - London	Imperial College of Science Technology and Medicine

Consequently, the data retrieved from the completed questionnaires is hard to be considered a statistical population. Averaging answers per country is a result of at the most 4 answers.

Despite of these drawbacks, analysing the data seemed to be sometimes easier on a country-perspective basis. Even where only one or few answers per country exists, this should be considered representative, as long as there are national systems for postgraduate education.

Meanwhile, because of space limitation in tables or graphics editing, in the next sections of the Report, only country and city name will be used when mentioning a specific institution.

2. Master or master type studies

As mentioned before, a total of 27 answers were received from institutions offering Master or Master type programmes. A total of 17 European countries are represented in the survey, most of them by a single answer.

2.1 Academic structure

The term of Master Degree was used only in the sense of an intermediate degree of 1-2 years (e.g. MSc in England/Ireland) and not as some first degrees of 4 years (e.g. MEng in UK).

The table 2 contains the name and abbreviation for the master qualification in each country together with an English translation (if applicable).

Table 2

AT	Diplom-Ingenieur	Dipl.-Ing. (D.I.)
BE	Diplome d'Etudes Approfondies	DEA
BG	Master (magister) in Civil engineering	
DE	Diplomingenieur	M.Sc.
EE	Tehnikateaduste magister	M.Sc.
ES	Diploma de Postgrado	
FI	Diplomi-insinööri	Dipl.ins.(DI)
FR	Diplome d'Etudes Approfondies	DEA
GR	Metaptyhiako Diploma	
LT	Statybos mokslų magistras	M.Sc
LV	Inženierzinātņu maģistrs	M.Sc.Ing.
NO	Sivilingeniör	siv.ing (MSc)
PL	Magister	M.Sc.
PT	Mestrado	
RO	Diploma de studii aprofundate	
SK	Inžinier	Ing.
UK	Master of Science	M.Sc.

According to the WG D questionnaire, the master (or master type) studies offered by various institutions can be taught programmes, research programmes or taught and research programmes. As a result of choosing between these options, the returns reveal 10 institutions offering taught master programmes and 17 institutions offering taught and research programmes. No respondent mentioned a research programme as option.

For the few countries with multiple answers, the type of programme seem to be a “national rule” in Germany (all 3 answers showing a taught programme); taught and research programmes are mentioned in Greece (one out of 4 answers), in Poland (one out of 3 answers) and in Romania (one out of 2 answers). For France, both returns reveal a taught and research programme.

Regarding the full-time or part-time master studies, in 17 institutions this type of postgraduate programme is open only to full-time students and in 10 institutions to both part-time and full-time students. For the second category, the percentage of enrolled part-time students is between 1% (NO - Trondheim) and 80% (PT - Beira Interior Covilha). The most frequent percentages encountered are between 10% and 20%.

The duration of master studies, as a result of 27 returns, is limited or fixed by regulations (lower, upper or both limits) in 15 countries and not fixed in 2 countries. However, there were answers from Germany (Hamburg) and Poland (Warsaw) indicating no imposed limits for the master studies duration. The minimum, maximum and typical duration of master studies as mean values per country are shown in figure 2.

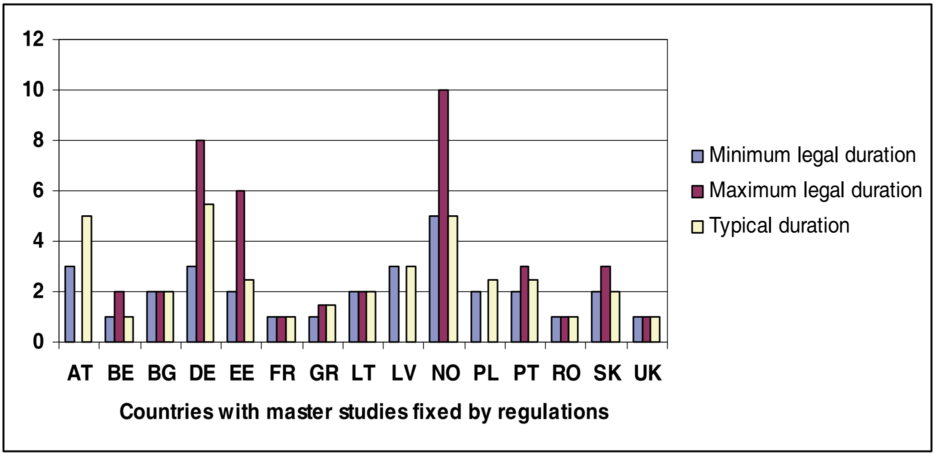


Figure 2. Duration of master or master type studies

The typical age of students on receiving the master degree without interrupting the studies after getting the first degree, as mean values (or representative values) per country, is shown in figure 3.

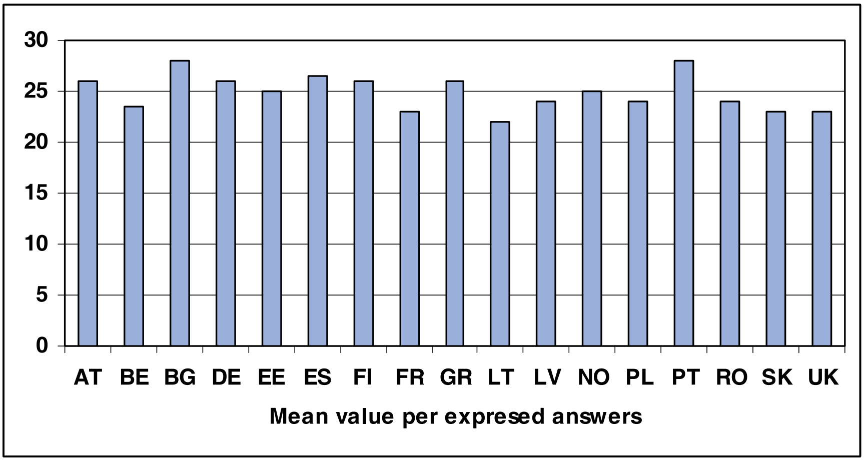


Figure 3. Typical age of Master programmes graduates

2.2 International dimension

When the WG D questionnaire was conceived, initially a special topic dedicated to a so-called “European Master” was introduced. This degree was meant as a master qualification based on a programme, having a substantial European dimension, which is recognised in the award of the degree. Such a qualification would have a significant input from another country and may be regulated by an agreement between a consortium of universities.

After receiving a first set of answers and a brief analysis of results was presented at the second meeting of the working group in Barcelona, a discussion about the “European Master” topic led to the conclusion that there were no reasons to define such a degree. From all the returns, only one university (PL - Bialystok Technical University) considered its degree an European Master, only by offering course units covered by teachers from other countries. The working group members decided to change the topic and to ask about a possible “International dimension” of the Master studies. A new, revised form of the questionnaire was sent to all partner institutions, in order the obtain information related to the new topic. In the context of WG D questionnaire, the international dimension of a Master programme should mean the result of co-operation between foreign universities, with some requirements to be fulfilled in order to accomplish this co-operation:

- part of the research work to be undertaken in another country;
- part of the course units to be covered by teachers from other countries;

- membership of the Examination Board to include at least one member from another country;
- part of the presentation or defence to be taken in another language;
- other requirements.

A number of 16 returns were received to the revised form of the questionnaire.

Despite the limited number, a general trend is obvious, the majority of answers revealing no international dimension of the Master studies. Only 4 answers (AT - Vienna, PL - Gliwice and Bialystok, RO - Bucharest) considered their programmes as a co-operation between own and foreign universities, by accomplishing one ore more of the previous requirements.

By contrary, most respondents expressed the interest of their departments (institutions) to develop a master programme with international dimension and to support setting up an EUCEET working group on this subject.

2.3 Joint development of a "study programme" at advanced (Master-type) level (CDA)

Within the Higher education action of SOCRATES programme entitled ERASMUS, was introduced since the academic year 1996 - 1997 a distinct activity called "Projects for the joint development of study programmes at advanced level", in short CDA, as part of the Institutional Contract concluded between the University and the European Commission.

Out of all received answers only two university developed, together with universities from at least three participating countries, a CDA project in the field of Civil Engineering (AT - Vienna, NO - Trondheim).

2.4 Admission procedure to the Master or Master type studies

According to the questionnaire, there were 5 options (multiple answers possibility) for the respondents regarding the admission criteria:
- directly after the first degree;
- after an admission examination;
- after the completion of an intermediate degree;
- through a transfer when in a lower degree;
- other.

The WG D questionnaire has for each option further more details (according to the student's nationality – home student, EU, other European country or other). Thus, a detailed presentation of the answers in graphical or tabular form is quite difficult. The table 3 contains the answers of all respondents corresponding to "home students". The distribution of options are emphasising the general trend of all answers, very few of them being different for other student categories.

When admitting students for Master or master-type programmes, some special entry difficulties arise in relation to recognition and grants. Concerning the recognition, 5 institutions consider this a special problem for home students (GR - Athens, Patras, Thessaloniki, PL - Warsaw, SK - Bratislava), while 15 institutions only for foreign students (BE - Liege, DE - Hamburg, ES - Barcelona, FI - Helsinki, FR - Lyon - INSA, FR - Lyon -ENTPE, GR - Patras, GR - Xanthi, LT - Vilnius, PL - Gliwice, PL - Warsaw, PT - Beira Interior Covilha, PT - Coimbra, RO - Bucharest, UK - London - IC). Although some answers are mentioning also EU students, the recognition problems rise mostly for students from other European or non-European countries.

Table 3

No.	Country/ City/ Institution	directly after the first degree	after an admission examination	after the completion of an intermediate degree	other
1	AT - Vienna			X	
2	BE - Liege	X			
3	BG - Sofia		X		
4	DE - Darmstadt				X
5	DE - Hamburg	X			
6	EE - Tallinn	X			
7	ES - Barcelona		X		
8	FI - Helsinki		X		
9	FR - Lyon - INSA		X		
10	FR - Lyon -ENTPE		X		
11	GR - Athens	X			
12	GR - Patras	X			
13	GR - Thessaloniki	X			
14	GR - Xanthi	X			
15	LT - Vilnius	X	X		
16	LV - Riga	X		X	
17	NO - Trondheim	X			
18	PL - Bialistock	X		X	
19	PL - Gliwice	X			X
20	PL - Warsaw	X	X		
21	PT - Beira Interior Covilha	X			
22	PT - Coimbra	X		X	
23	RO - Bucharest		X		
24	RO - Cluj		X		
25	SK - Bratislava	X			
26	UK - London - IC	X			

However, the most frequent problems are due to grant allocation (both for home students and student from abroad). Most of the answers emphasized this aspect, as shown in the next table (4).

Table 4. Special difficulties due to grants allocation for

No.	Country/ City/ Institution	home students	students from abroad
1	BE - Liege		X
2	EE - Tallinn	X	X
3	ES - Barcelona	X	X
4	FI - Helsinki		X
5	FR - Lyon - INSA	X	X
6	FR - Lyon -ENTPE		X
7	LT - Vilnius	X	X
8	NO - Trondheim		X
9	PL - Gliwice		X
10	PL - Warsaw		X
11	PT - Coimbra	X	X
12	RO - Bucharest		X
13	RO - Cluj	X	
14	SK - Bratislava		X
15	UK - London - IC	X	X

One answer received from DE - Dresden mentioned as other special difficulty: the German language level of candidates from abroad.

2.5 Number of places and financial support

According to the WG D questionnaire, the respondents had to choose from one or more criteria regarding the limitation of the available number of places for master or master-type studies: (i) national regulations, (ii) university regulations, (iii) department/faculty regulations and/or (iv) financial resources. The tables 5 and 6 contain the chosen criteria for “home” and foreign (EU, other European or non-European countries) students, as they were expressed in the received answers. It is obvious that the number of available places is independent from national regulations due to the university’s authonomy, but the financial resources represent the most frequent limitation.

Out of 25 expressed answers, for 22 institutions (88%) a recognition procedure is needed for a student with a foreign qualification. No such a recognition procedure is needed for BG - Sofia, FI - Helsinki and PT - Beira Interior Covilha.

However, only for 10 answers (40%), a satisfactory performance in a competitive examination is needed (BG - Sofia, DE - Darmstadt, FI - Helsinki, FR - Lyon - ENTPE, GR - Athens, GR - Thessaloniki, GR - Xanthi, NO - Trondheim, RO - Cluj, UK - London - IC).

Table 5

THE AVAILABLE PLACES FOR MASTER STUDIES AND HOME STUDENTS ARE LIMITED BY:	national regulations	university regulations	department/faculty regulations	financial and other resources
AT - Vienna			X	X
BE - Liege			X	
BG - Sofia			X	X
DE - Hamburg			X	X
EE - Tallinn	X	X	X	X
ES - Barcelona			X	X
FR - Lyon -ENTPE			X	X
GR - Athens	X	X		
GR - Patras		X	X	
GR - Thessaloniki	X	X		
GR - Xanthi	X	X	X	
LT - Vilnius	X	X	X	X
LV - Riga		X	X	
NO - Trondheim	X			
PL - Bialistock		X	X	
PL - Gliwice			X	
PL - Warsaw		X	X	X
PT - Covilha			X	
PT - Coimbra		X	X	X
RO - Bucharest	X			
RO - Cluj		X		X
SK - Bratislava	X			
UK - London - IC			X	

Table 6

THE AVAILABLE PLACES FOR MASTER STUDIES AND HOME STUDENTS ARE LIMITED BY:	national regulations	university regulations	department/faculty regulations	financial and other resources
AT - Vienna			X	X
BE - Liege			X	X
BG - Sofia			X	X
DE - Darmstadt			X	
DE - Hamburg			X	X
ES - Barcelona			X	X
FI - Helsinki				X
FR - Lyon -ENTPE			X	X
GR - Patras		X	X	
NO - Trondheim			X	X
PL - Bialistock				X
PL - Gliwice			X	
PL - Warsaw				X
PT - Covilha			X	
PT - Coimbra		X	X	X
SK - Bratislava				X
UK - London - IC			X	

Regarding the financial support, tutorial fees must be paid only in 11 institutions out of 26 expressed answers (42%). A guaranteed subsistence should be proved in a quite similar percentage (36% - 9 institutions), with no match between corresponding answers (as shown in table 7).

The major sources of support to cover the fee and the subsistence costs of the master student were defined in the Questionnare as:
- a home public agency (i.e. ministry of education, national or regional research council, national or regional authority, etc)
- from industry (either privately or publicly owned)
- by parental means
- by the own means of the graduate student, i.e. through a part-time job or other self-funded means.

Most respondents "ticked" all these options in the answers but only few gave a rough percentage on how these contributions are distributed. Figure 4 shows some examples.

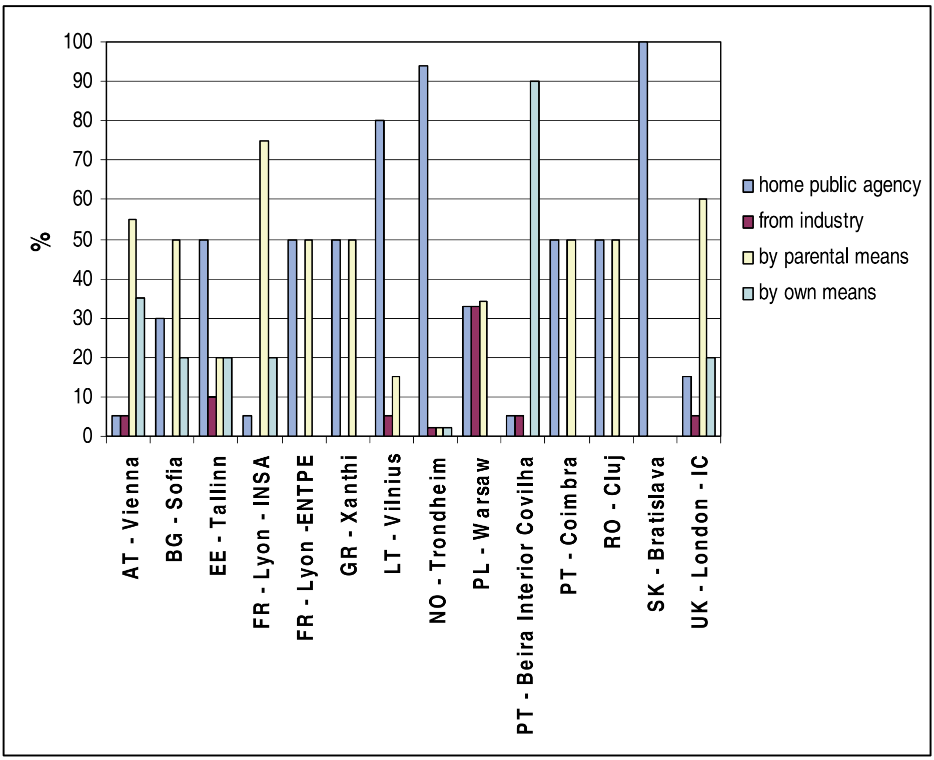


Figure 4. Master studies funding for various institutions

Also, 43% of the received answers reveal the possibility of master students to receive payment for the contribution to undergraduate teaching.

Table 7

Country/ City/ Institution	tutorial fees	proving subsistence	Country/ City/ Institution	tutorial fees	proving subsistence
AT - Vienna	Y	N	GR - Thessaloniki	N	N
BE - Liege	Y	Y	GR - Xanthi	N	N
BG - Sofia	Y	Y	LV - Riga	Y	N
DE - Darmstadt	N	N	NO - Trondheim	N	Y
DE - Dresden	N	N	PL - Bialistock	N	N
DE - Hamburg	N	N	PL - Gliwice	Y	Y
EE - Tallinn	N	N	PL - Warsaw	N	N
ES - Barcelona	Y	N	PT - Covilha	Y	N
FI - Helsinki	N	Y	PT - Coimbra	Y	N
FR - Lyon - INSA	Y	Y	RO - Bucharest	N	N
FR - Lyon -ENTPE	Y	Y	RO - Cluj	N	N
GR - Athens	N	N	SK - Bratislava	N	Y
GR - Patras	N	N	UK - London - IC	Y	Y

2.6 Activities during the Master studies

2.6.1 Coursework and research activity during Master or Master-type studies

According to the returns to the questionnaire, 26 out of 27 expressed answers (except DE- Dresden) are showing a compulsory coursework activity during the postgraduate training toward a Master or Master-type degree. A more comprehensive information about the number of hours spent in course units, curricula structure and the form in which this course units are offered in each institution can be obtained by consulting the EUCEET data-base (the completed returns). The maximum number of contact hours/year (generally in the first year when the programme is longer), as it resulted after disregarding the wrong or incomplete answers, is shown in figure 5.

In almost all returns, the coursework is assessed by a final examination. In 14 out of 26 institutions (54%) credits are offered, but in only one institution (NO - Trondheim) these are ECTS credits. In 21 of the expressed answers (80%) the performance of the Master student taking course units is monitored.

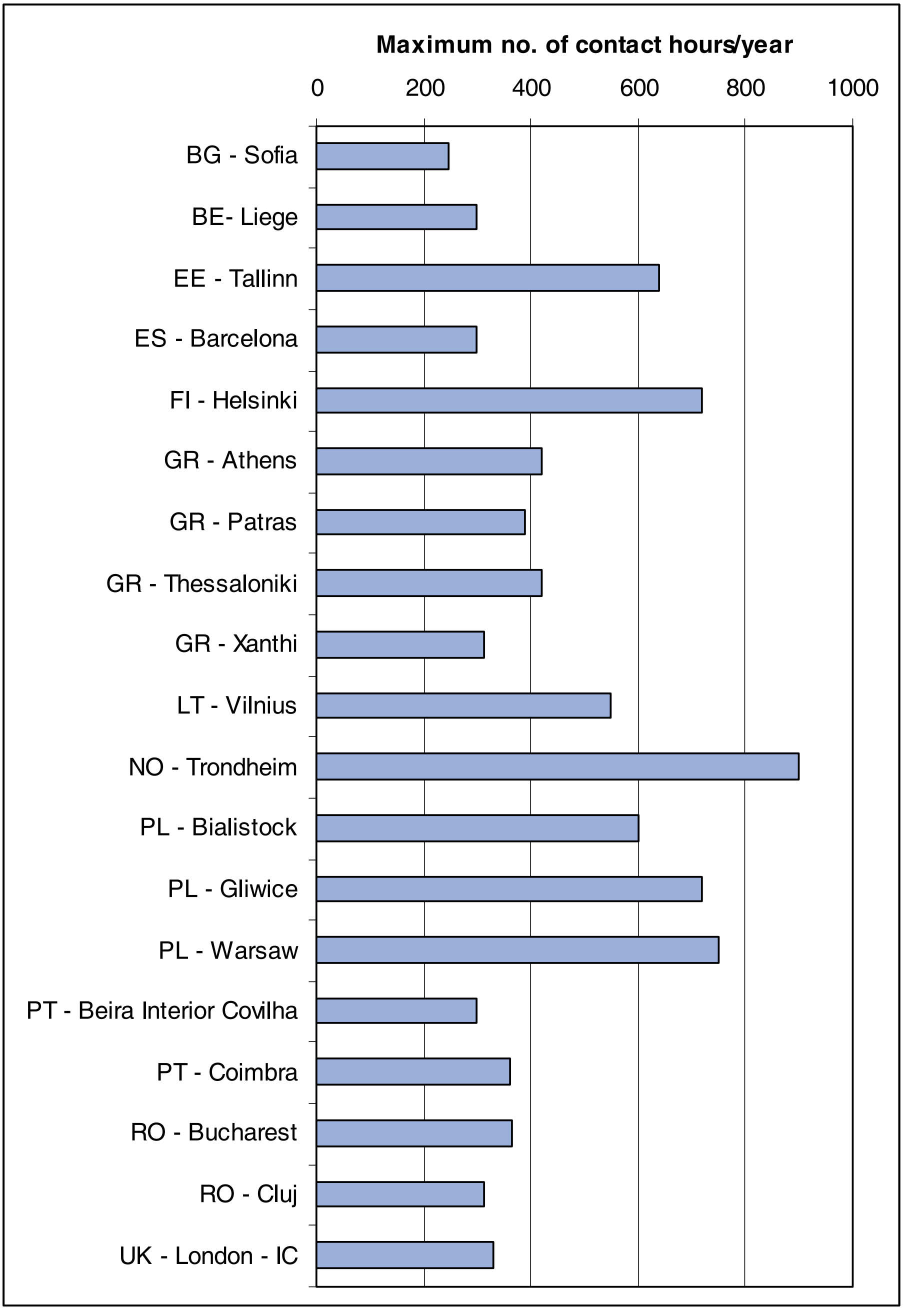


Figure 5. Maximum number of contact hours/year spent in various master programmes

In 16 institutions out 17 mentioning a taught and research programme the students have to undertake compulsory research work in order to get the Master or Master-type postgraduate degree. In other 2 cases the research work is “possible” (DE - Darmstadt) or “recommended (PL - Gliwice).

The students may take Master degrees while based at another location for 13 respondents (48%) and the average percentage of students for which the location of the research work is outside the institution is between 5% and 50% (minimum values for France and UK and the maximum value for Finland).

The subject of the research must be an active research area in the department in 10 returns, while for other 6 this condition is not compulsory. The theme of the research is normally assigned at the beginning of the postgraduate studies for 4 answers (24%) and after a specified period of coursework or preparatory training for 11 answers (65%). In 2 cases, both possibilities are available (ES - Barcelona, FR - Lyon - ENTPE).

Out of a total workload corresponding to the Master degree of 100 assigned units, the number of units corresponding to the research work is less than 40 for 13 returns, between 40 and 60 for 5 returns and more than 60 for one return (PT - Beira Interior Covilha).

Regarding the other activities normally expected from the postgraduate students, the multiple choices of the questionnaire and the scattered data made a comprehensive presentation impossible. However, some brief information can be withdrawn. The participation of master students in group seminars is compulsory for 7 returns, optional for other 8 and not expected in 2 answers. The attendance of national conferences is compulsory for 3 returns, optional for 16 returns and not expected for 7 returns. The attendance of international conferences is optional for 7 returns and not expected for other 13.

The attendance of intensive courses is compulsory for 1 return, optional for 6 returns and not expected for 12 returns.

The presentation of the work results in the department is compulsory for 18 answers, optional for 6 answers and not expected in 2 answers. The presentation of the same results at national or international conferences is mostly optional or not expected.

The contribution to teaching (supervision of undergraduate laboratory work, tutoring undergraduate groups, tutoring undergraduate thesis work, marking of undergraduate assessments/homework) is compulsory for 2 answers, optional for 7 answers and not expected for other 10 answers.

2.6.2 Supervision of postgraduate studies

During the Master or Master-type studies the student needs a personal supervisor in 9 out of 23 expressed answers (40%), in all cases the same person is supervising the student’s Master Thesis.

Out of 23 expressed answers to this topic, the thesis supervisor of a Master student can be a professor in charge with a course unit from the curriculum in 22 institutions (95%), any professor or lecturer in the department in 18 institutions (78%) or any researches in the department in 11 institutions (48%).

The thesis subject is assigned by agreement between the student and the proposed supervisor for 22 answers (95%), by a resolution of the Scientific Board, taking into account the preferences of the students, for 10 answers (4%) or by a resolution of the Scientific Board, without taking into account the preferences of the students, for 2 answers (1%).

2.7 Awarding of Master degree

2.7.1 Submission of Master Thesis

For all received answers, the language used in the written and final oral presentation of the Thesis is the native language of the country. However, 12 returns expressed the possibility to use an alternative language for writing the thesis but only 7 returns revealed a possible presentation of the thesis in an alternative language. Mostly, the alternative language is English.

Credits are allocated to the master Thesis in 16 institutions.

The master Thesis is a previously unpublished substantial written report for 26 of the answers (93%), a collection of individual or co-authored scientific papers with an introduction and/or commentary for 2 answers (less then 1%) and other option in 1 answer.

2.7.2 Thesis examination and degree awarding

The oral presentation of the Thesis work for an open audience is part of the assessment procedure in 25 out of 28 received answers (the only 3 exceptions are NO – Trondheim, PL – Bialystok and UK – London IC).

The composition of the Thesis examination board as number of members show as follows: internal examiners between 1 and 7, external examiners between 0 and 3 and other examiners (in the questionnaire there is mentioned an independent chairperson) 0 or 1. The average composition of the examination board is shown in the figures 6 and 7. The "average" means an average value for those respondents who answered with an interval of numbers (from minimum to maximum) and not by a precise figure.

According to the questionnaire, the respondents have the following options for the examination (assessment) board nomination, multiple choices being possible: (i) by the supervisor; (ii) by the scientific committee of the institution; (iii) by the academic authorities; (iv) by the national ministry; (v) other. The received answers are condensed in the graph shown in figure 9. Merging the expressed options (i), (ii), and (iii) one can conclude that in most cases the choice is a local decision.

When awarding the Master degree, the examiners can base their assessment decision on reading the thesis (all 28 answers); on the oral presentation of the thesis work (27 answers); on the answers given to the examination board (23 answers); on the answers given to the general audience (10 answers) and/or on an oral examination of the candidate including detailed questions on the thesis (15 answers). To this question, multiple answers were possible.

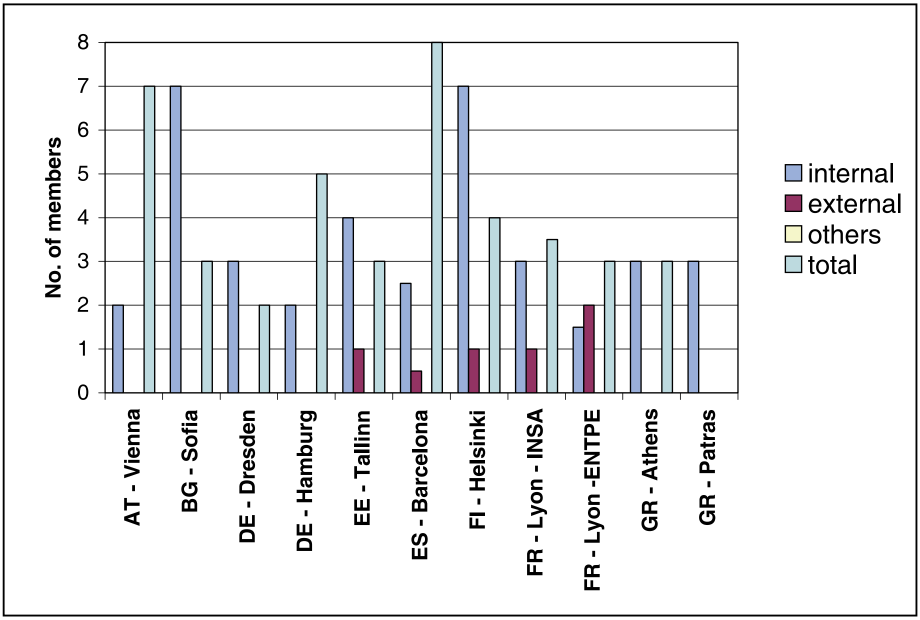


Figure 6. Average composition of the examination board

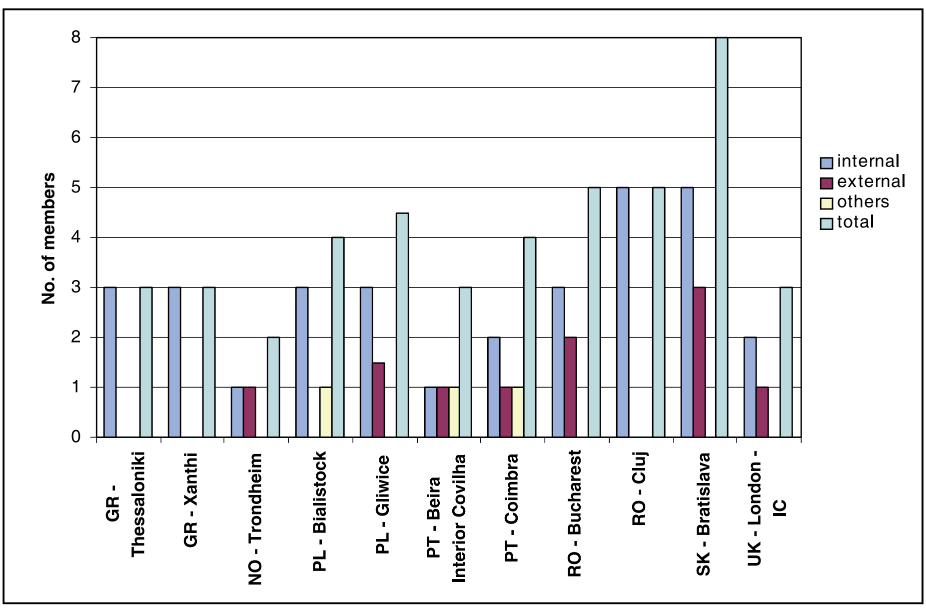


Figure 7. Average composition of the examination board (continued)

Figure 10 shows the typical duration of the oral part of the examination according to the expressed answers. If there is an upper limit for the oral examination (usually not explicitly mentioned), the correspondent institution has a red mark close to its bar. A short duration of 1 hour is usual for most respondent institutions.

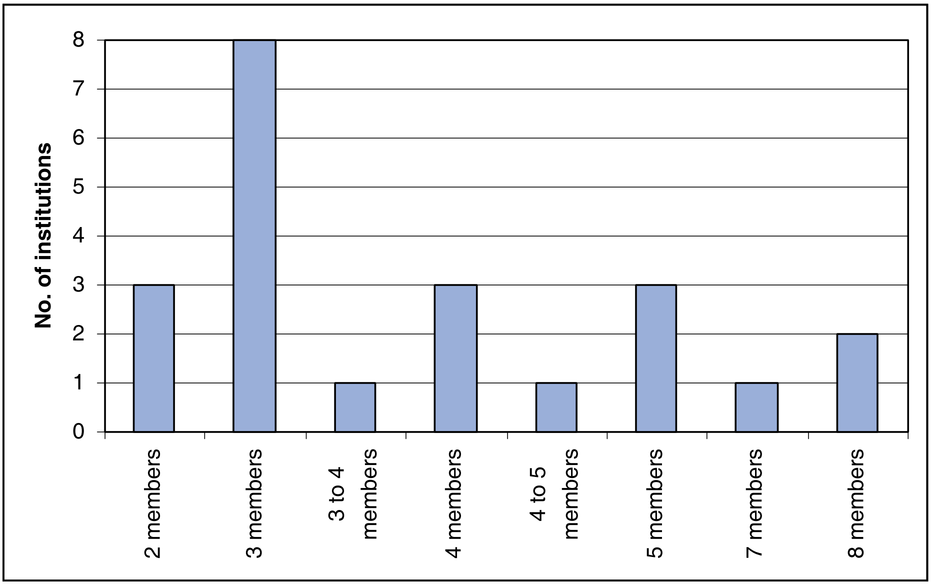


Figure 8. Distribution of the institutions according to the total number of examiners

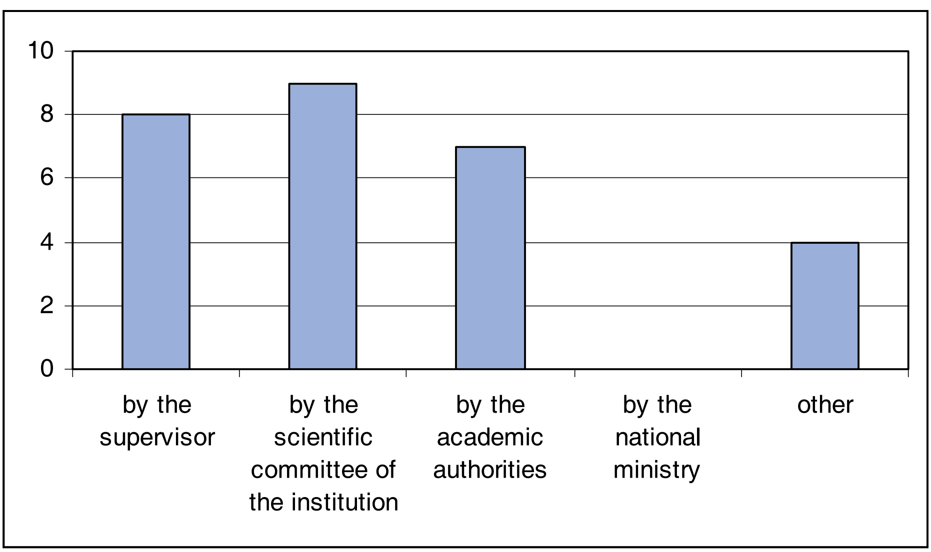


Figure 9. Choosing the examination board

Four respondent mentioned an oral examination taken behind closed doors (NO – Trodheim, PL – Bialystok and Warsaw, UK – London IC).

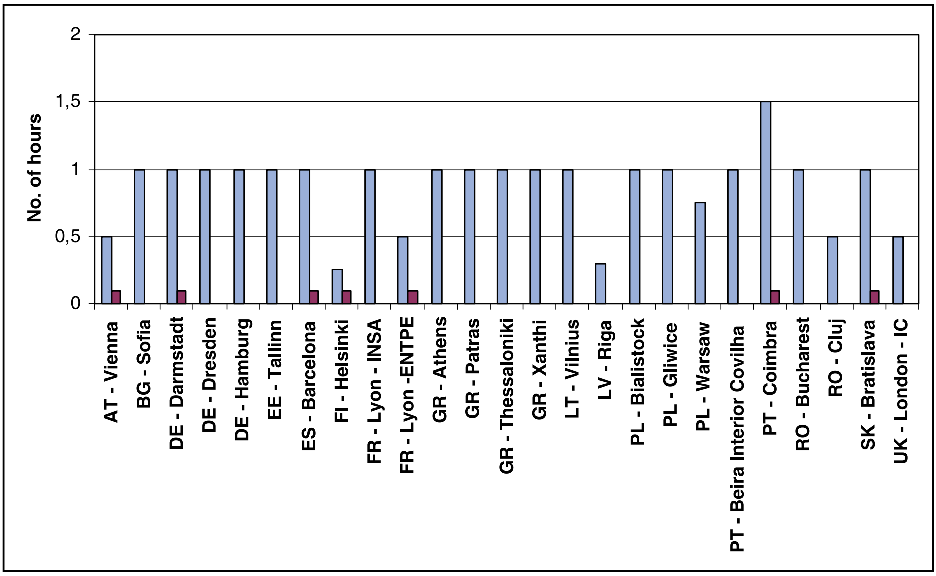


Figure 10. Typical duration of the oral examination

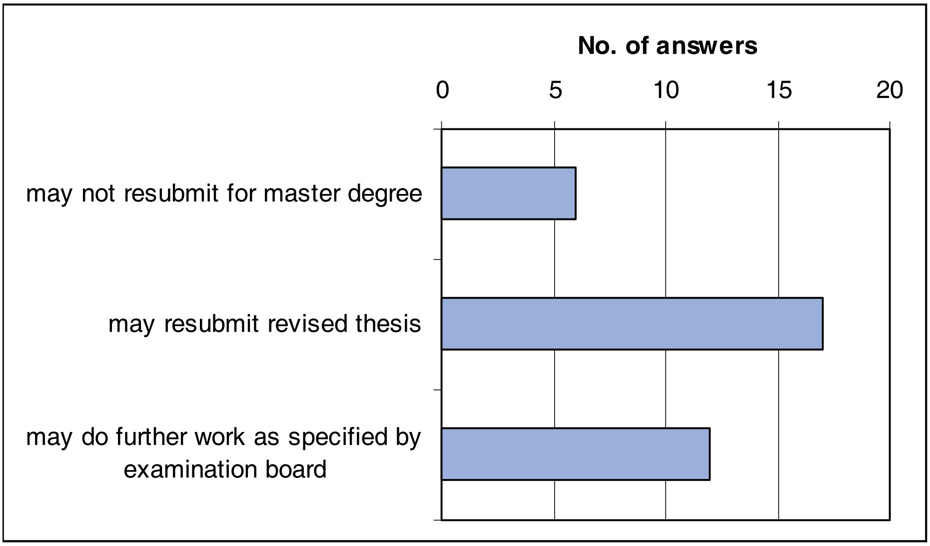


Figure 11. Student's options in case of examination failure

Once a master student fails the final examination, the questionnaire provides the following options for the respondent institution (multiple possible choices): (i) the student may not resubmit for master degree; (ii) may resubmit a revised Thesis; (iii) may do further work as specified by the examination board.

For the Thesis re-submission, in some cases there is a time limit between 1 and 2 years. The graph of the received answers is shown in figure 11.

In 23 institutions out of 28 respondents (82%) there is a grading system for the master degree, based on the quality of the work. The top grade, where a grading system exists, is awarded in a percentage between 1.5 and 100%, with an average value of 36%.

2.8 Statistics on recent master graduates

The statistical information provided by the received answers is briefly condensed in the next graphs, as minimum, maximum and mean encountered values for every question. The average number of master students per year is between 2 and 350. This scattered data is obvious due to the dimension of the institution and the level at which the respondent referred to (department, faculty, university).

The typical age of graduates ranges between 23 and 28 years with an average of 25.5 years. The percentage of female master graduates ranges between 10% and 50%, with an average of 29%. The proportion of home country graduates ranges between 22% and 100% (see figure 12).

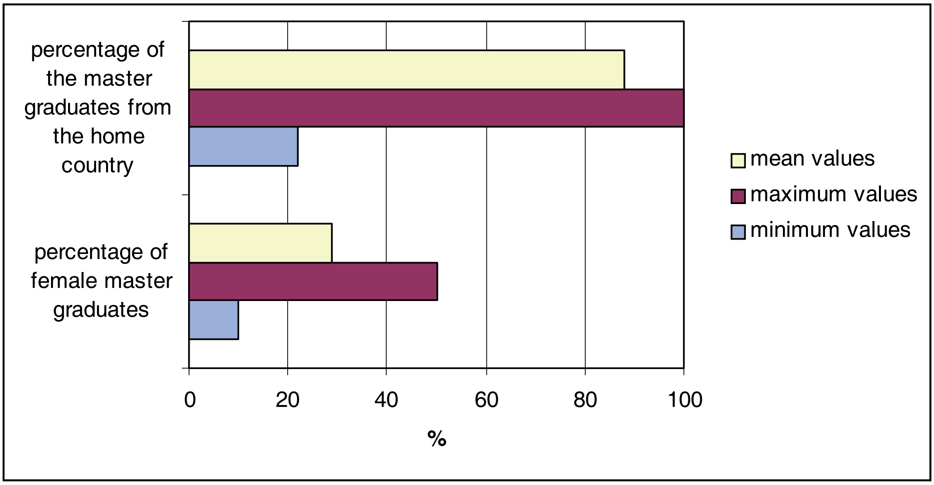


Figure 12. Statistics on recent master graduates

The first destination of students after completing their master or master-type studies is shown in the figure 13. The percentages represent the mean values out of all completed answers to this specific question. Minimum and maximum encountered values can be seen in figure 14.

Some peculiar national trends can be observed in detail by consulting the EUCEET database.

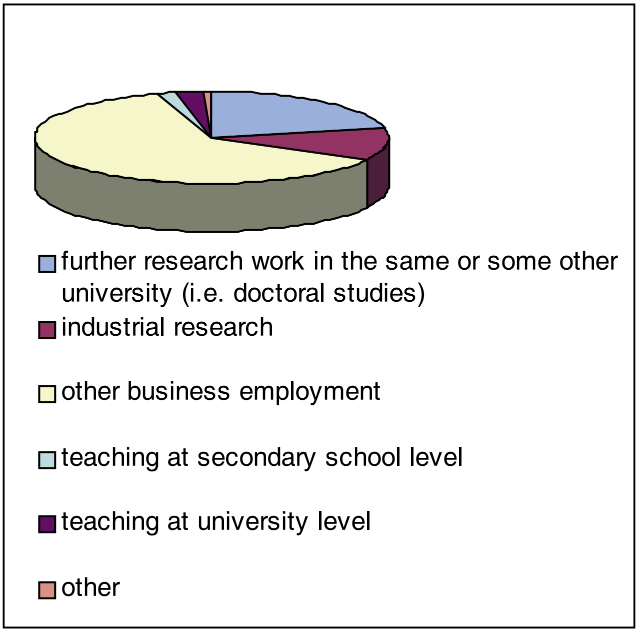


Figure 13. First destination of students after completing their master or master-type studies

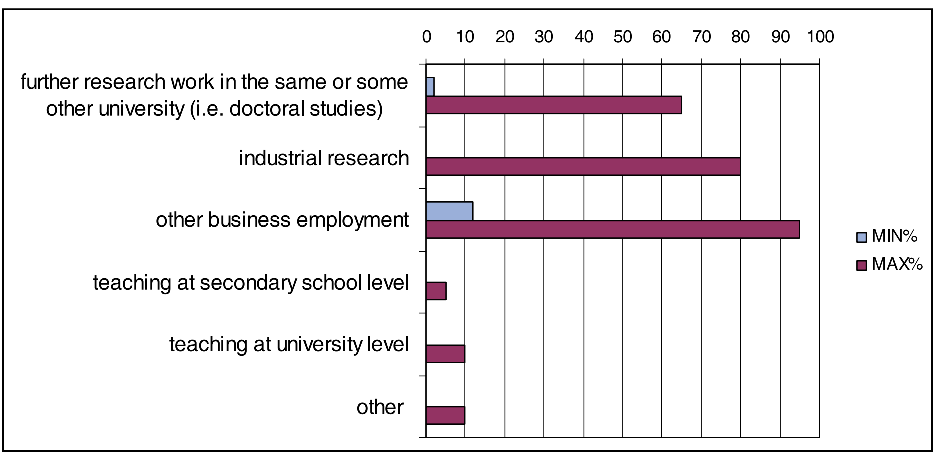


Figure 14. Minimum and maximum encountered values

3. Doctoral studies

3.1 Academic structure

In the context of the WG D questionnaire, the doctoral qualification is considered the highest degree awarded by the university to students leaving the university system, being necessary but not sufficient for those wishing to pursue an academic career. The table 8 contains the name and abbreviation for the doctoral qualification in each country together with an English translation (if applicable).

Table 8

AT	Doctor technicus		Dr. techn.
BE	Doctorat en Sciences Appliquées	Philosophical Degree in Engineering	Ph.D.
BG	Doctor Engineer		Dr.
CZ	Doktor – PhD	Philosophy Doctor	PhD
DE	Doktor-Ingenieur	Doctor-Engineer	Dr.-Ing.
EE	Tehnikadoktor	Doctor of Engineering	Dr.Eng.
ES	Ingenieria Civil		
FI	Tekniikan tohtori, filosofian tohtori	Doctor of Science in Technology, Doctor of Philosophy	TkT, FT
FR	Doctorat	Doctoral thesis	
GR	Didaktoriko Diploma	Doctoral Degree	
HU		Philosophy Doctor	PhD
IT	Dottorato in Ing. civile ed ambientale	Doctorate in Civil and Environmental Engineering	Dott.
LT	Daktaras	Doctor	Dr. (PhD)
LV	Inženierzinātņu doktors		Dr.Sc. Ing.
NO			
PL	Doktor nauk technicznych	Doctor of technical science	PhD
PT	Doutoramento	Doctoral	
RO	Doctor Stiinte Tehnice	Doctor of technical science	Dr.Ing.
SK	Doktor	Philosophy Doctor	PhD
UK		Philosophy Doctor	PhD

The respondents were asked to choose between two types of doctoral programme: a research programme or a taught and research programme. The answers have a quite uniform distribution between these options: out of 37 answers (institutions), 16 are offering a research doctoral programme and 21 are offering a taught and research doctoral programme.

It is interesting to notice that even for answers from the same country, there is no sign of a “national rule”, as shown in the following figure (15).

Regarding the full-time or part-time doctoral studies, the answers have a similar distribution: out of 36 returns, 15 are mentioning a doctoral programme open only to full-time students, 19 for both part-time and full-time students and 2 answers are incorrect. For the second category, the percentage of enrolled part-time students is between 5 and 100%, with an average of 57.2%. On a country-base perspective, national or common rules seem to be available (similar answers from institutions belonging to the same country), a distribution as in the table 9 being available.

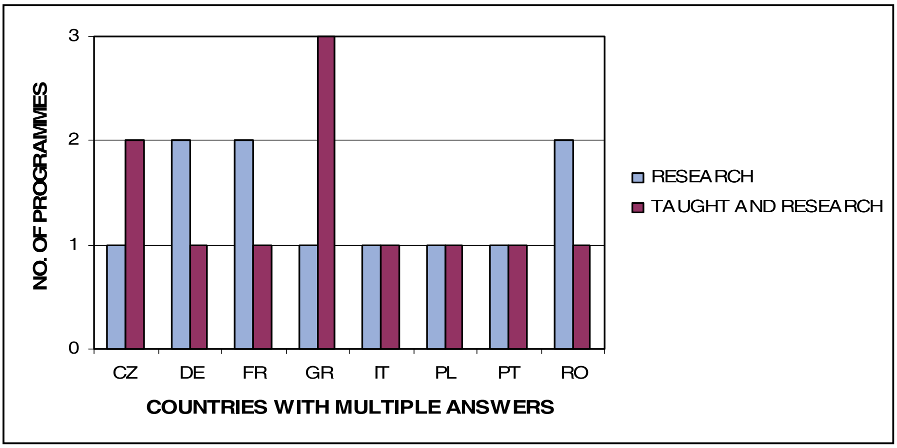


Figure 15. Type of programmes in various countries

The duration of doctoral studies, as a result of 36 returns, is limited or fixed by regulations (lower, upper or both limits) in 31 cases and not fixed in the other 5. For the first category, the minimum, maximum and typical duration of the doctoral qualification as mean values (or representative values) per country are shown in the figure 16.

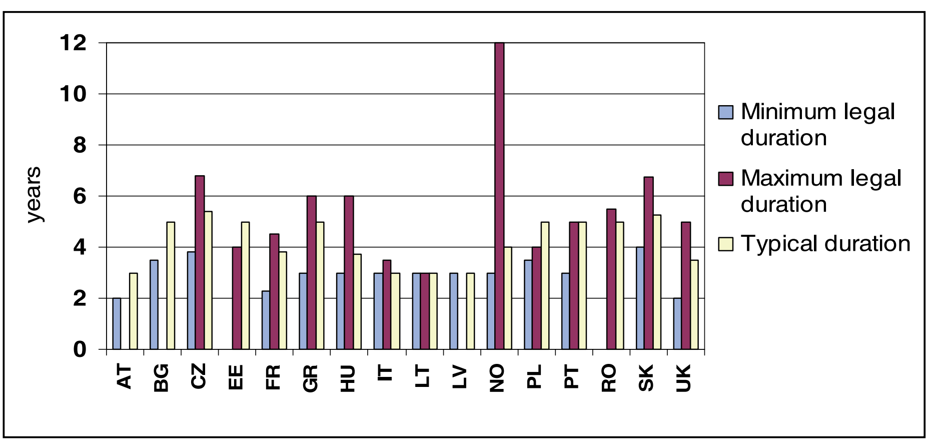


Figure 16. Duration of Doctoral studies

The typical age of students on receiving the doctoral degree without interrupting the studies as mean values (or representative values) per country is shown in figure 17.

Table 9

AT	Both full-time and part-time students
BE	Both full-time and part-time students
BG	Both full-time and part-time students
CZ	Both full-time and part-time students
DE	Both full-time and part-time students
EE	Only full-time students
ES	Both full-time and part-time students
FI	Both full-time and part-time students
FR	Only full-time students
GR	Only full-time students
HU	Only full-time students
IT	Only full-time students
LT	Only full-time students
LV	Only full-time students
NO	Both full-time and part-time students
PL	Only full-time students
PT	Only full-time students
RO	Both full-time and part-time students
SK	Both full-time and part-time students
UK	Both full-time and part-time students

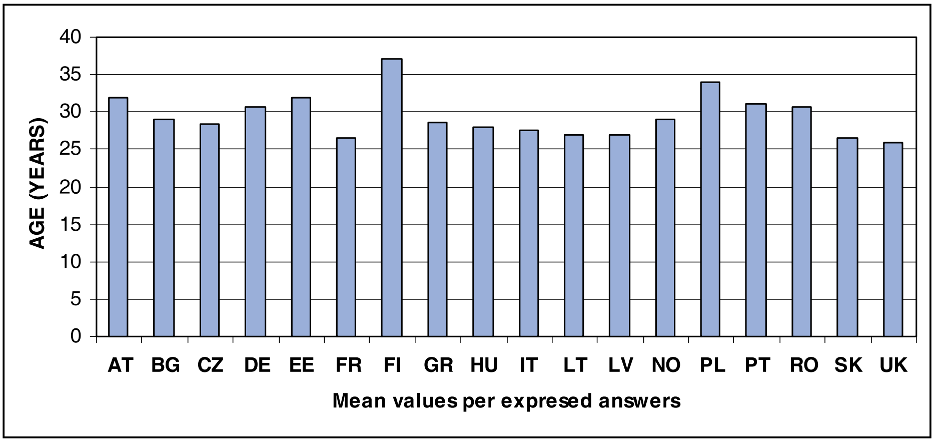


Figure 17. Typical age of Doctoral programmes graduates

3.2 International dimension

Initially conceived to assess a possible definition and eventual lead to an "European Doctorate", the set of questions regarding this topic was changed after the third meeting of Working Group D in Barcelona, when, based on the already received answers, it became obvious that such a degree is difficult to be sustained. As it was mentioned in the minute of that meeting, only Spain has awarded a title called "European Doctorate". In those circumstances, the topic was changed in the second form of the questionnaire, leading to a more common idea of international co-operation in doctoral degree awarding. Out of 35 expressed answers regarding the international dimension of the doctoral programme as a result of co-operation with other foreign universities, only 11 of the answers are positive. More than two thirds of the respondent institutions do not have an international co-operation system in the doctoral degree awarding. Out of the 11 answers mentioning an international dimension of the doctoral programme, in 5 cases this is a result of a convention between universities in several European countries, in 4 cases a EU initiative and in 2 cases a convention between the home country and countries outside Europe.

It is very difficult to withdraw a conclusion regarding this topic from a country-based perspective, taking into account the limited number of answers and the fact that different answers were received from the same country, as it is shown in the next example (table 10):

Table 10

CZ	Brno	International dimension
	Pardubice	No international dimension
	Prague	International dimension
IT	Firenze	International dimension
	Milano	No international dimension
PT	Covilha	No international dimension
	Coimbra	International dimension
RO	Bucharest	No international dimension
	Cluj Napoca	International dimension
	Iasi	International dimension
SK	Bratislava	No international dimension
	Zilina	International dimension

Only 7 respondents answered to the question regarding the necessary requirements for the international dimension of the doctoral studies (with multiple answers possibility). All of them picked the option regarding the option "- part of the research work undertaken in another country", only 2 the option "- part of the course units covered by teachers from other countries", 5 the option considered "- the membership of the Examination Board to include at least one member from another country" and 2 respondents chose the option "- part of the presentation or defense taken in another language". Other 2 respondents mentioned other requirements.

More optimistic were the answers regarding the interest of respondents to develop a doctoral programme with international dimension, 17 mentioning "YES" or "POSSIBLE" as option.

3.3 Intermediate qualification

In many national educational systems there is an intermediate qualification between the first degree (undergraduate programmes) and the doctoral studies. A typical example is the French DEA (*Diplôme d'Etudes Approfondies*) but there are also some Master or Master type programmes which are optional or compulsory in order to have access to the doctoral degree. Table 11 contains the name of the intermediate qualifications in each country, as they appear in the completed questionnaires.

Table 11

1	BE	Diplôme d'Etudes Approfondies
2	EE	Magister
3	ES	Diploma Estudios Avanzados
4	FI	Tekniikan lisensiaatti
5	FR	Diplôme d'Etudes Approfondies
6	HU	Doktori tanulmányok Absolutoriuma
7	NO	Civilingenior
8	PL	Magister
9	PT	Mestrado
10	RO	Diploma de studii aprofundate
11	UK	MSc

From a total of 36 answers, 13 answers (11 countries) are indicating a possible intermediate qualification and only in 6 of them the qualification is compulsory for the admission in the doctorate programme. Again, one can notice differences between the compulsory character of the intermediate qualification in answers received from the same country (FR, PT, SK).

The duration of the intermediate qualification is generally fixed by regulations (only for Finland there is a negative answer) and the minimum, maximum and typical duration of these programmes are shown in figure 18.

3.4 Admission procedure

According to the questionnaire, respondents had 5 options (multiple answers possibility) regarding the admission criteria:
- directly after the first degree;
- after an admission examination;
- after the completion of an intermediate degree;
- through a transfer when in a lower degree;
- other.

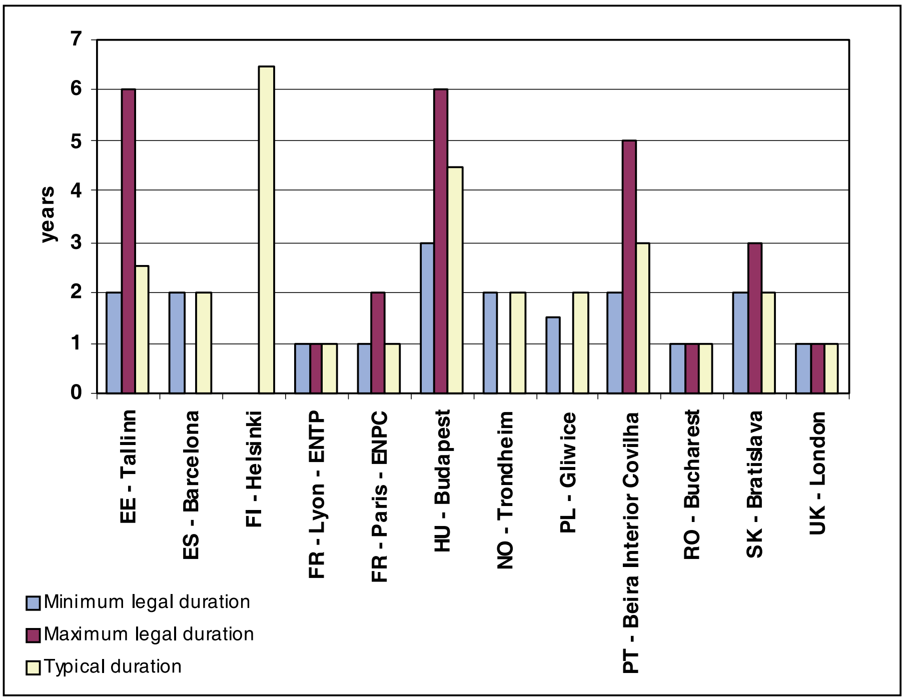


Figure 18. Duration of the intermediate qualification

Because each option in the questionnaire has further more details (according to the student's nationality – home student, EU, other European country or other) a detailed presentation of the answers as graphs or tables is quite difficult. The table 12 contains the answers of all respondents corresponding to "home students". The distribution of options emphasises the general trend of all answers, very few of them being different for other student categories.

Table 12

No.	Country/ City/ Institution	directly after the first degree	after an admission examination	after the completion of an intermediate degree	through a transfer when in a lower degree	other
1	AT - Vienna	X				
2	BE - Liege	X		X		
3	BG - Sofia	X				
4	CZ - Brno	X				
5	CZ - Pardubice		X			
6	CZ - Prague		X			
7	DE - Berlin	X			X	
8	DE - Darmstadt	X				
9	DE - Hamburg	X				
10	EE - Tallinn			X		
11	ES - Barcelona	X				
12	FR - Paris - ENPC			X		
13	FR - Lyon - INSA		X			
14	FR - Lyon - ENTP					X
15	FI – Helsinki	X		X		
16	GR - Athens	X				
17	GR - Patras	X				
18	GR - Thessaloniki	X				
19	GR - Xanthi	X				
20	HU - Budapest		X			
21	IT – Firenze		X			
22	IT – Milano		X			
23	LT – Vilnius	X				
24	LV - Riga	X				
25	NO - Trondheim			X		
26	PL - Gliwice			X		
27	PL - Warsaw		X			
28	PT - Covilha			X		
29	PT - Coimbra	X		X		
30	RO - Bucharest		X			
31	RO - Iasi		X			
32	RO - Cluj		X			
33	SK - Bratislava			X		
34	SK - Zilina		X			
35	UK - London - IC	X		X		

Some special entry difficulties arise when admitting students for doctoral programmes, related to recognition and grants. Concerning the recognition, 6 institutions consider this a special problem for home students (FR - Lyon - ENTP, GR - Athens, GR - Thessaloniki, GR - Patras, IT - Firenze, RO - Iasi) and 14 institutions for EU students (AT - Vienna, FR - Paris - ENPC, FR - Lyon - ENTP, GR - Athens, GR - Thessaloniki, GR - Xanthi, IT - Firenze, IT - Milano, PL - Warsaw, PT - Beira Interior Covilha, PT - Coimbra, RO - Bucharest, RO - Cluj, UK - London - IC). However, the most frequent problems are due to grant allocation (both for home students and students from abroad). Most of the answers emphasised this aspect, as shown in the next table (13):

Table 13

No.	country / institution	home students	EU students
1	EE - Tallinn	X	X
2	ES - Barcelona	X	X
3	FR - Paris - ENPC	X	X
4	FR - Lyon - ENTP	X	X
5	FI - Helsinki	X	
6	HU - Budapest		X
7	IT - Firenze	X	
8	IT - Milano	X	
9	LT - Vilnius	X	X
10	NO - Trondheim	X	X
11	PL - Gliwice	X	
12	PL - Warsaw	X	
13	PT - Beira Interior Covilha	X	X
14	PT - Coimbra	X	X
15	RO - Bucharest	X	
16	RO - Iasi	X	
17	RO - Cluj		X
18	SK - Bratislava	X	X
19	SK - Zilina	X	X
20	UK - London - IC	X	X

3.5 Number of places and financial support

In most situations the available number of places for doctoral studies is limited by one of the following criteria: (i) national regulations, (ii) university regulations, (iii) department/faculty regulations and/or (iv) financial resources.

The tables 14 and 15 contain the chosen criteria for “home” and “EU” students, as they were expressed in the received answers. It is obvious that the number of available places is independent from national regulations due to the university’s autonomy but the most frequent limitation is represented by the financial resources.

In 91% of the expressed answers (30 out of 33), a recognition procedure is needed for a student with a foreign qualification. Only 50% of the answers are mentioning the need of a satisfactory performance in a competitive examination.

Regarding the financial support, tutorial fees must be paid only in 14 institutions out of 35 (40%), which answered to this question. A guaranteed subsistence should be proved in the same percentage, with no match between corresponding answers (as shown in table 16).

Table 14

THE AVAILABLE PLACES FOR DOCTORAL STUDIES AND HOME STUDENTS ARE LIMITED BY:	national regulations	university regulations	department/faculty regulations	financial and other resources
AT - Vienna			X	X
BE - Liege			X	
CZ - Brno			X	
CZ - Pardubice				X
CZ - Prague			X	
DE - Berlin			X	
DE - Darmstadt				X
DE - Hamburg			X	X
EE - Tallinn	X	X	X	
ES - Barcelona			X	X
FR - Paris - ENPC			X	X
FR - Lyon - INSA				X
FR - Lyon - ENTP			X	X
FI - Helsinki		X	X	
GR - Athens	X	X		
GR - Patras		X	X	
GR - Tessaloniki	X	X		

THE AVAILABLE PLACES FOR DOCTORAL STUDIES AND HOME STUDENTS ARE LIMITED BY:	national regulations	university regulations	department/faculty regulations	financial and other resources
GR-Xanthi		X		
HU - Budapest	X	X		X
IT - Firenze		X		X
IT - Milano		X		X
LT - Vilnius	X	X	X	X
LV - Riga		X	X	
NO - Trondheim				X
PL - Gliwice			X	
PL - Warsaw		X		
PT - Covilha		X		X
PT - Coimbra		X	X	X
RO - Bucharest	X			X
RO - Iasi	X			
RO - Cluj		X	X	X
SK - Bratislava	X			
SK - Zilina	X			
UK - London - IC			X	X

The student's doctoral studies can be funded by different means: a home public agency (i.e. ministry of education, national research council, national or regional authority, etc), from industry, by parental means or by the own means of the graduate student (i.e. through a part-time job). The percentages of these options, as they were expressed in the received answers, are shown in figure 19.

Table 15

THE AVAILABLE PLACES FOR DOCTORAL STUDIES AND E.U. STUDENTS ARE LIMITED BY :	national regulations	university regulations	department/faculty regulations	financial and other resources
BE - Liege			X	
CZ - Brno				X
CZ - Prague				X
DE - Berlin			X	
DE - Darmstadt				X
DE - Hamburg			X	X
ES - Barcelona			X	X
FR - Paris - ENPC			X	X
FR - Lyon - INSA				X
FR - Lyon - ENTP			X	X
FI - Helsinki		X	X	X
GR - Athens	X	X		
GR - Patras		X	X	
GR - Thessaloniki	X	X		
GR-Xanthi		X		

THE AVAILABLE PLACES FOR DOCTORAL STUDIES AND E.U. STUDENTS ARE LIMITED BY :	national regulations	university regulations	department/faculty regulations	financial and other resources
HU - Budapest			X	
IT - Firenze				X
IT - Milano		X		X
NO - Trondheim			X	X
PL - Gliwice			X	
PL - Warsaw		X		
PT - Covilha		X		X
PT - Coimbra		X	X	X
RO - Bucharest		X		
RO - Iasi				X
RO - Cluj	X			
SK - Bratislava				X
SK - Zilina				X
UK - London - IC			X	X

Also, 79% of the expressed answers reveal the possibility of doctoral student to receive payment for the contribution to undergraduate teaching, as shown in table 17.

3.6 Activities during the doctoral studies

3.6.1 Location of the research activity and supervision of doctoral studies

The doctoral research work is allowed to take place outside the home institution, which awards the degree in 24 out of 31 expressed answers (78%).

Table 16

Country/ City/ Institution	tutorial fees	proving subsistence		Country/ City/ Institution	tutorial fees	proving subsistence
AT - Vienna	Y	N		GR - Thessaloniki	N	N
BE - Liege	Y	Y		GR - Xanthi	N	N
BG - Sofia	N	Y		HU - Budapest	Y	N
CZ - Brno	N*	N		IT - Firenze	N	N
CZ - Pardubice	N	N		IT - Milano	Y	N
CZ - Prague	N	N*		LV - Riga	Y	N
DE - Berlin	N	N		NO - Trondheim	N	Y
DE - Darmstadt	N	Y		PL - Gliwice	Y	Y
DE - Dresden	N	Y		PL - Warsaw	Y	N
DE - Hamburg	N	N		PT - Covilha	Y	N
EE - Tallinn	N	N		PT - Coimbra	Y	N
ES - Barcelona	Y	N		RO - Bucharest	N*	N
FR - Paris - ENPC	Y	Y		RO - Iasi	Y	Y
FR - Lyon - INSA	N	Y		RO - Cluj	N	N
FR - Lyon - ENTP	Y	Y		SK - Bratislava	N	Y
FI - Helsinki	N	Y		SK - Zilina	N	Y
GR - Athens	N	N		UK - London - IC	Y	Y
GR - Patras	N	N				

According to the returns to our questionnaire, out of 36 expressed answers in 19 institutions the doctoral studies are supervised by a scientific board. The number of the scientific board members can be as low as 3 (AT) or as high as 33 (SK) - see figure 20. The scientific board is elected by a larger body in 9 institutions (47%), appointed by the Head of department in 4 institutions (21%) and chosen in another way in 3 institutions (16%).

The main tasks of the scientific board as they are expressed in the answers have a percentage distribution as shown in figure 21.

Table 17

AT - Vienna	Y	FI - Helsinki	N
BE - Liege	Y	GR - Athens	Y
BG - Sofia	Y	GR - Patras	Y
CZ - Brno	Y	HU - Budapest	Y
CZ - Pardubice	N	IT - Firenze	N
CZ - Prague	Y	IT - Milano	Y
DE - Berlin	Y	LT - Vilnius	Y
DE - Darmstadt	Y	LV - Riga	Y
DE - Dresden	Y	NO - Trondheim	Y
DE - Hamburg	N	PT - Beira Interior Covilha	Y
EE - Tallinn	Y	RO - Bucharest	Y
ES - Barcelona	N	RO - Iasi	N
FR - Lyon - INSA	Y	SK - Bratislava	Y
FR - Lyon - ENTP	Y	UK - London - IC	Y

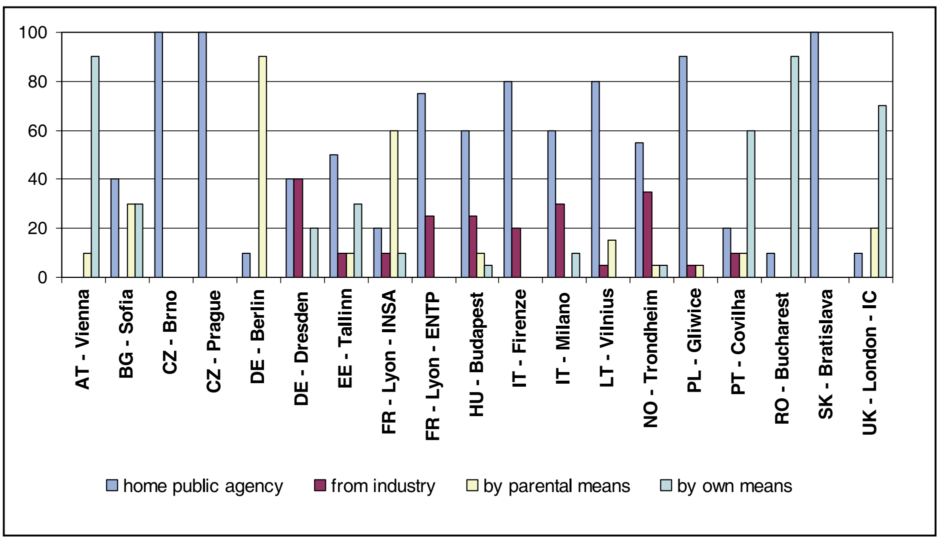


Figure 19. Doctoral studies funding

The student needs a personal supervisor during her/his coursework in 24 answers (67%) and in all cases the same person is supervising the thesis work.

The subject of the Doctoral Thesis must be an active research area in the department in 32 received answers out of 36 (89%). It is normally assigned at the beginning of the doctoral studies in 25 institutions (70%) and after a specified period of coursework or preparatory training in 11 institutions (30%).

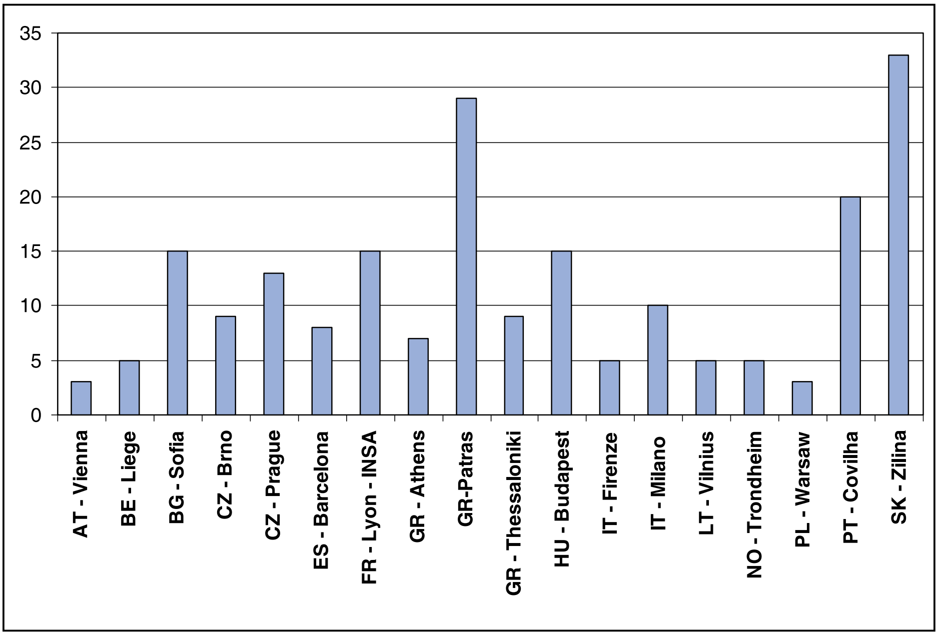


Figure 20. The scientific board composition

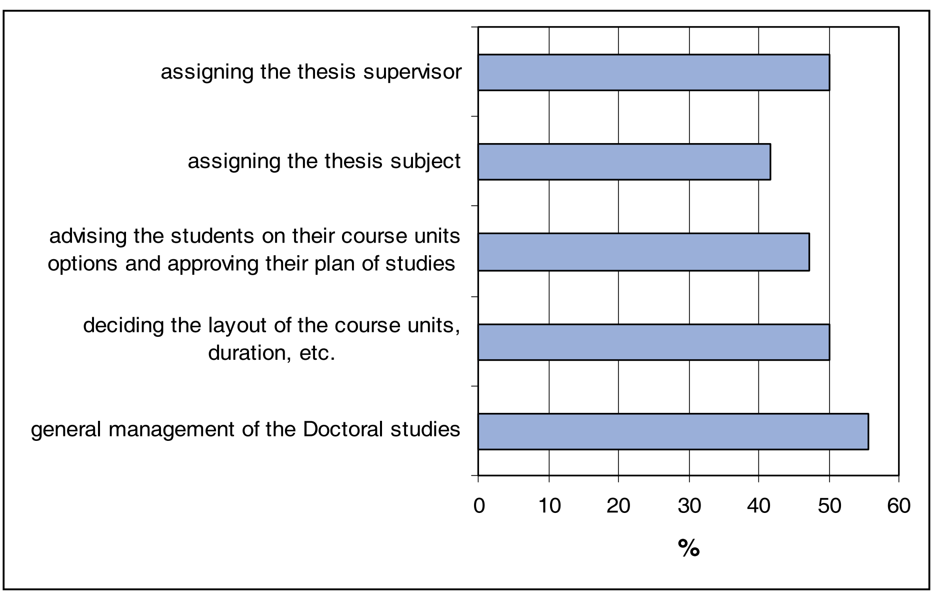


Figure 21. Main tasks of the scientific board

The Thesis supervisor of a doctoral student can be any professor or Ph.D. lecturer in the department in 33 institutions (92%), any Ph.D. researcher in the department in 24 institutions (67%), any professor or Ph.D. researcher in another institution in 22 institutions (61%). In both last situations, for 16 answers, the student needs a second supervisor who is a professor or lecturer in the department (i.e. "internal co-supervisor").

The Thesis subject is assigned by agreement between the student and the proposed supervisor for 29 answers (81%), by a resolution of the Scientific Board, taking into account the preferences of the student, for 13 answers (50%) or by a resolution of the Scientific Board, without taking into account the preferences of the student, for only one answer (3%).

3.6.2 Coursework

As it was already seen, some doctoral programmes are taught and research programmes. Regarding the specific question, 21 out of 36 respondents stated that students have to take course units during their doctoral training. In most cases, the course units are not specified in the curricula, they being chosen and sometimes temporarily created according to the previewed needs of the doctoral research. Also, the coursework in not necessarily undertaken as a common programme for all doctoral students. The number of teaching hours is itself very different from one programme to another, from 12 hour/year in AT - Vienna to 900 hours/year in NO - Trondheim. In figure 22 is shown the number of contact hour per year spent on actual coursework.

It is possible that the extreme values are due to a misunderstanding of the question (for example, the lowest value to represent the number of hour per week, or for the highest, the total number of contact hours spent in the whole programme of 2 or 3 years).

As to the type of contact hours offered, most institutions offer specialist graduate course units even though a consistent fraction of the contact hours is taken from the undergraduate programme (optional courses).

In all cases, the coursework is assessed by final examination. Many institutions (11) are offering credits but only few (5) are ECTS credits.

It is interesting to notice that for 15 institutions the student can take course units outside the civil engineering field when completing the doctoral programme. In 14 cases this contributes to the total credit rating.

Regarding the other activities undertaken by the doctoral student, the multiple choices of the questionnaire and the scattered data made a brief presentation impossible. The most encountered options on compulsory activities are the presentation of the research work's results in the department and the attendance of national or international conferences.

The contribution to teaching (any level) and the presentation of papers at national or international conferences are generally optional.

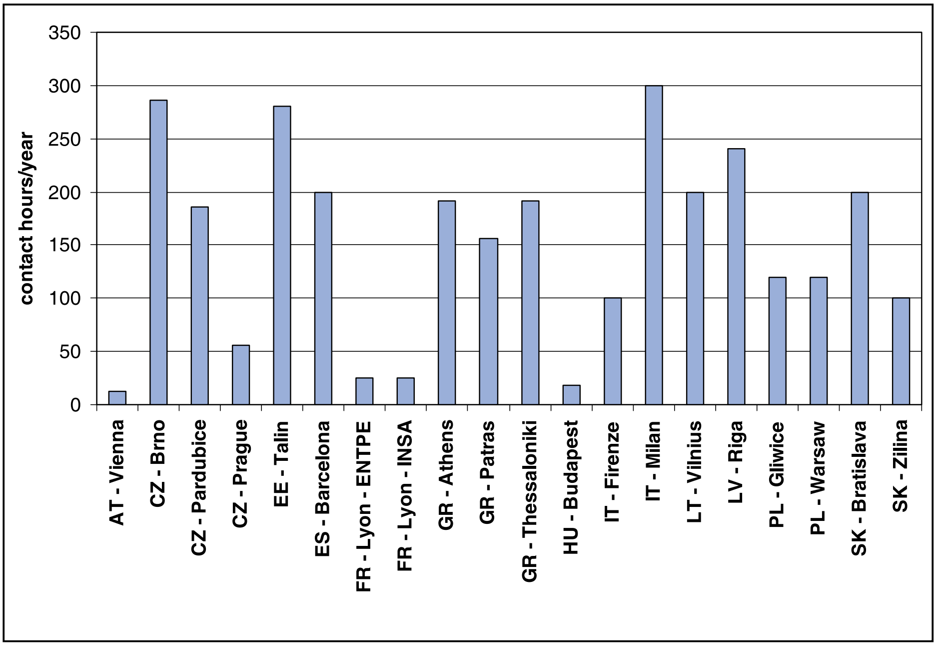


Figure 22. Number of contact hours/year spent in various doctoral programmes

3.7 Awarding of doctoral degree

3.7.1 Submission of doctoral Thesis

For almost all received answers, the language used in the written and final oral presentation of the Thesis is the native language of the country. However, 20 returns expressed the possibility to use an alternative language for writing the thesis and also for the final presentation. Mostly, the alternative language is English. For the affirmative answers, the percentage of using an alternative language is generally ranging between 1 and 10 %. Some noticeable exceptions are EE - Tallin with 50%/30% of the Thesis written/presented in English, ES - Barcelona with 55%/30%, FI - Helsinki with 90%/10% and NO - Trondheim with 90%/90% respectively.

The doctoral Thesis is a previously unpublished substantial written report for 33 of the answers (89%), a collection of individual or co-authored scientific papers with an introduction and/or commentary for 3 answers (less then 1%) and other option in 1 answer.

3.7.2 Thesis examination and degree awarding

The oral presentation of the Thesis work for an open audience is part of the assessment procedure in 36 out of 37 received answers (the only exception is in NO - Trondheim). The composition of the Thesis examination board is scattered as number of members: internal examiners between 1 and 70, external examiners between 0 and 20 and other examiners (in the questionnaire there is mentioned an independent chairperson) between 0 and 10 (!?). The average composition of the examination board is shown in the figures 23 and 24. The "average" means an average value for those respondents who answered with an interval of numbers (from minimum to maximum) and not by a precise figure. The answers for LV - Riga (70 internal members) and for BG - Sofia (24 members in total) are omitted on purpose, being "out of scale" for the graphs.

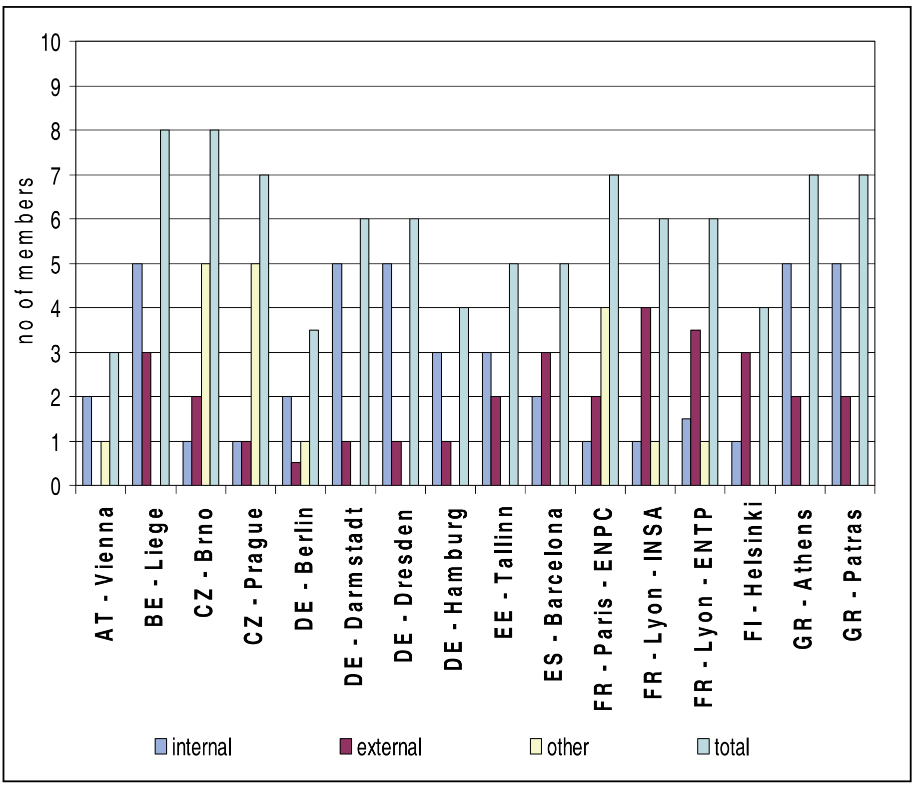


Figure 23. Average composition of the examination board

A more suggestive representation is shown in figure 25, regarding the total number of the examination board versus the number of received answers. Again, BG and LV are neglected because of the high values.

According to the questionnaire, the respondents have the following options for the examination (assessment) board nomination, multiple choices being possible: (i) by the supervisor; (ii) by the scientific committee of the institution;

(iii) by the academic authorities; (iv) by the national ministry; (v) other. The received answers are condensed in the graph shown in figure 26. Merging the expressed options (i), (ii), and (iii) one can conclude that in most cases the choice(iii) by the academic authorities; (iv) by the national ministry; (v) other. The received answers are condensed in the graph shown in figure 26. Merging the expressed options (i), (ii), and (iii) one can conclude that in most cases the choice is a local decision. Only in a few cases the decision is at the ministry level, generally for approving the local proposed members.

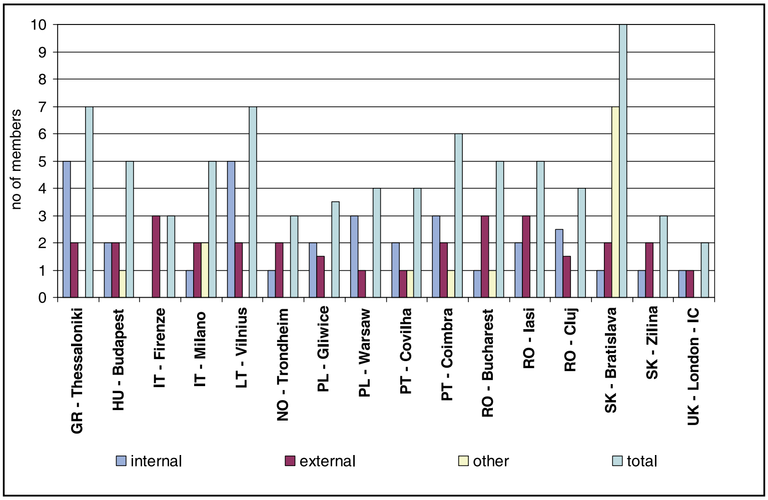


Figure 24. Average composition of the examination board (continued)

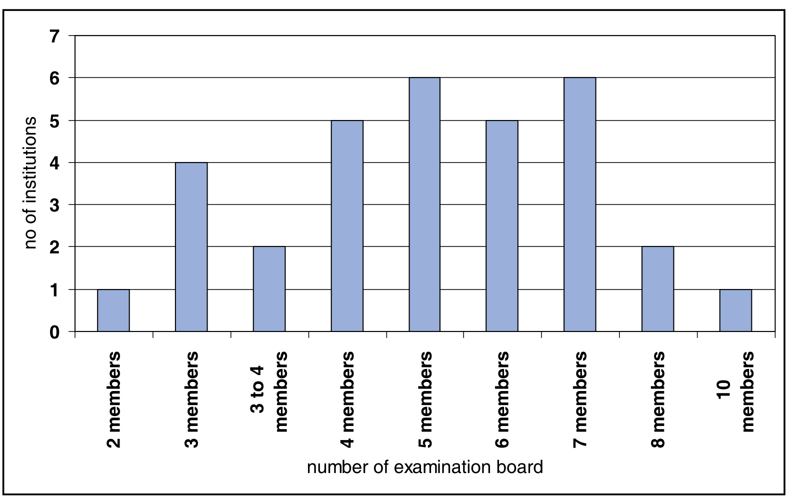


Figure 25. Distribution of the institutions according to the total number of examiners

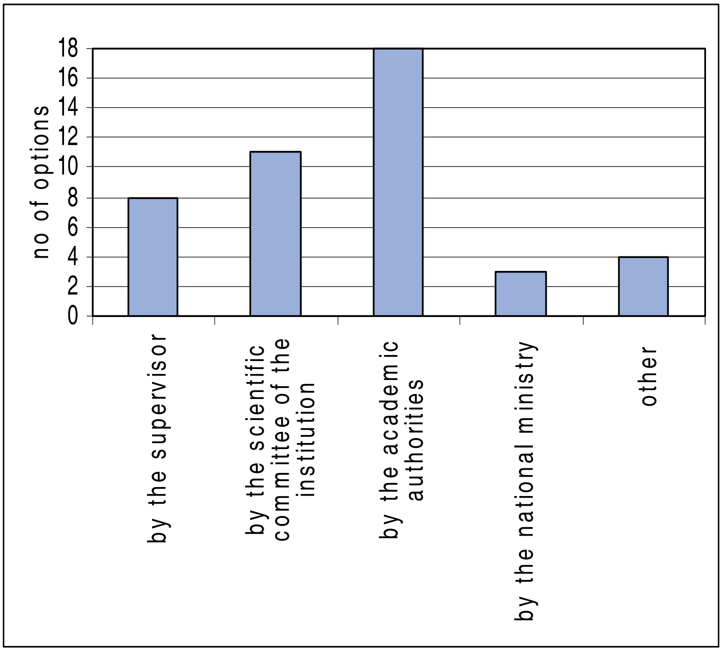


Figure 26. Choosing the examination board

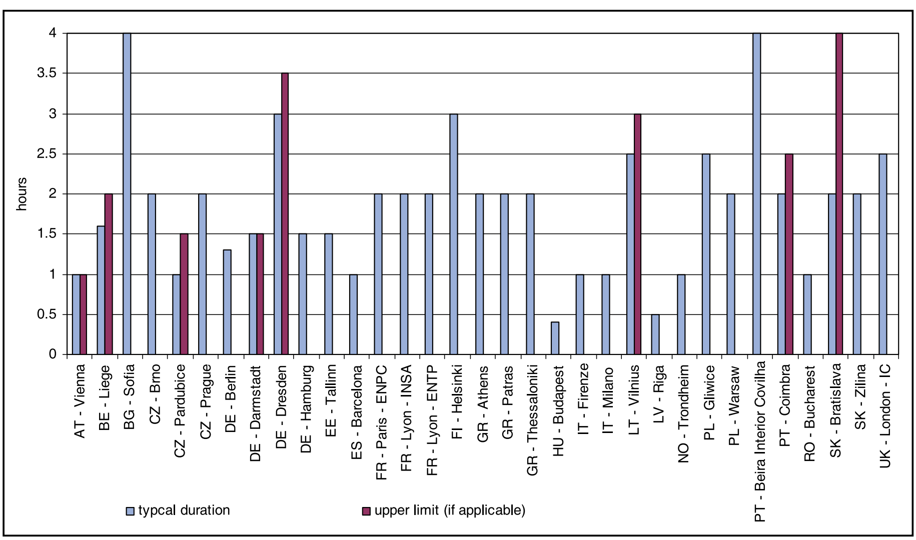


Figure 27. Typical duration of the oral examination

In figure 27 is shown the typical duration of the oral part of the examination according to the expressed answers. If an upper limit for the oral examination was mentioned, the corespondent value is specified on the graph. A short duration, between 1 and 2 hours, is usual for most respondent institutions. The longest duration occurs in BG - Sofia and PT - Beira Interior Covilha (4 hours). No respondent mentioned an oral examination taken behind closed doors.

Once a doctoral student fails the final examination, the questionnaire provides the following options for the respondent institution (multiple possible choices): (i) the student may not resubmit for doctorate; (ii) may resubmit a revised Thesis; (iii) may do further work as specified by the examination board; (iv) may be awarded a lower level qualification. For the Thesis re-submission, in some cases there is a time limit for this to occur. The graph of the received answers is shown in figure 28.

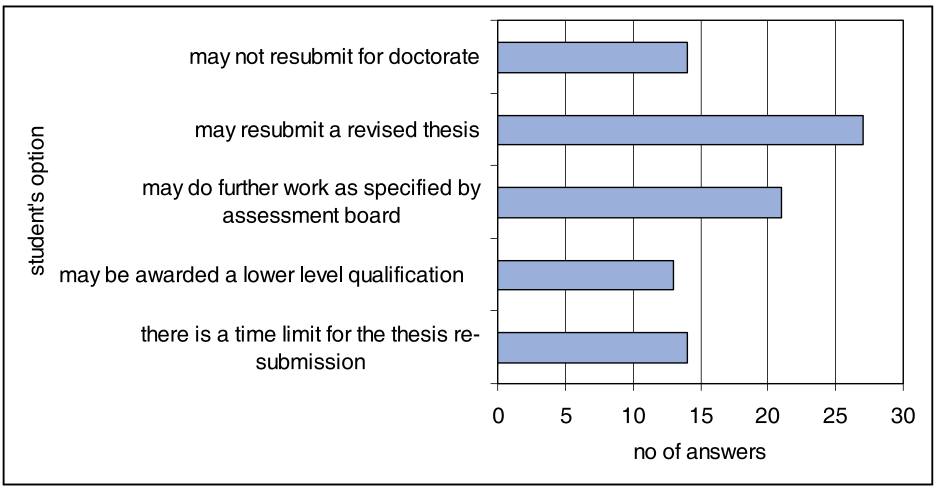


Figure 28. Student's options in case of examination failure

In 24 institutions out of 37 respondents (65%) there is a grading system for the doctoral degree, based on the quality of the work. The top grade, where a grading system exists, is awarded in a percentage between 5 and 100%, with a mean value of 52%.

3.8 Statistics on recent doctorates

The statistical information provided by the received answers are briefly condensed in the next graphs, as minimum, maximum and mean encountered values for every question (figure 29). The average number of doctoral students per year is not greater than 10 in as many as 18 institutions, is between 20 and 30 in 5 institutions and reaches 50 in one case (RO - Bucharest). This number is obvious related to the dimension of the institution and the level at which the respondent refers to (department, faculty, university).
The typical age of graduates ranges between 26 and 38 and the percentage of female doctoral graduates ranges between no female graduate and 48%. The proportion of home country graduates ranges between 10% and 100% and the proportion of graduates from abroad between 1% and 90% (this last case in ES - Barcelona).

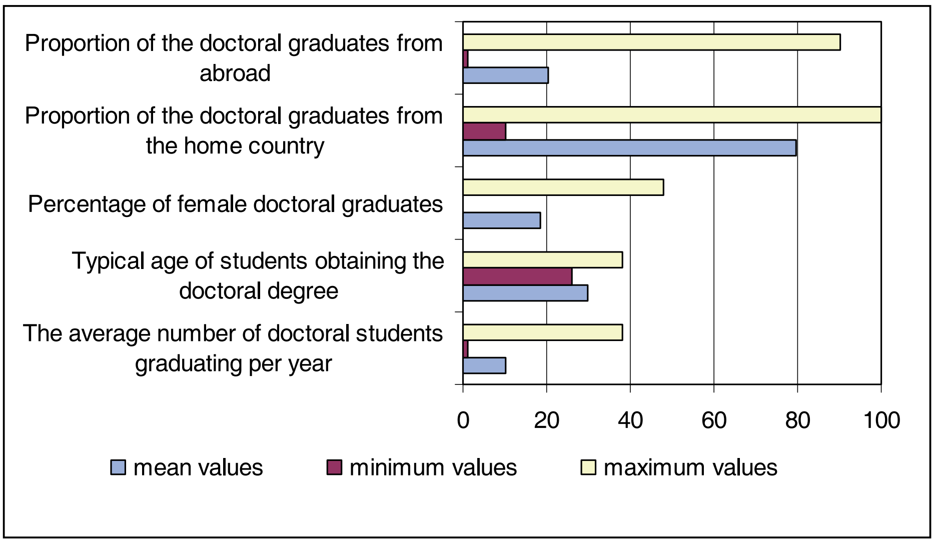


Figure 29. Statistics on recent doctorates

The answers regarding the first destination of students after completing their doctorate are shown in the next figure (30). The percentages represent the mean values out of all received answers. Some specific trends can be observed in detail by consulting the EUCEET database. The average over the whole sample shows quite similar (uniform) percentages of graduates doing further research work, teaching at university level or going to other business employment (≈ 28% each).

A lower rate shows the industrial research area (12%) and almost no graduates chose teaching at secondary school level. Other options, beside the ones mentioned in questionnaire and the incomplete answers cover 3 - 4%.

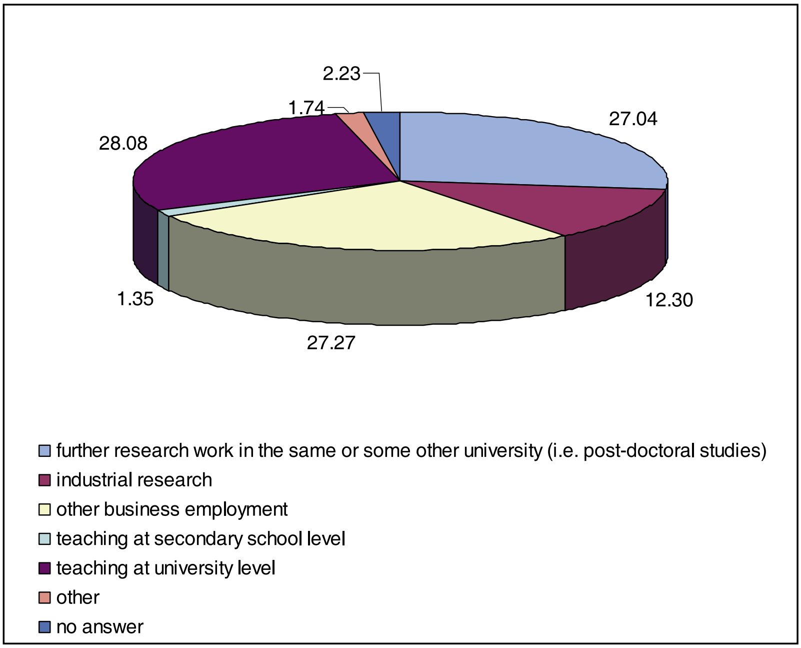


Figure 30. First destination of students after completing their doctorate

4. Continuing education

Another part of the activity of WG D was dedicated to the so-called Continuing Education. A special questionnaire on this topic was approved at the second meeting of the working group members in Barcelona and sent to all partner institutions. The content of this questionnaire is listed in the annex of this chapter.

Due to the very low number of returns to this questionnaire, drawing out trends on European scale is rather impossible. Moreover, the received data is very scattered for some topics of the 9 received answers (see table XXX below).

Most of the answers reveal that the responsibility for continuing education is located in a special unit of the university or at faculties/departments level. In only one case an external organisation is responsible.

The teachers/trainers involved in the continuing education activities are mostly and equally divided between own staff and external institutions; in only one case the special unit has its own training staff.

The size of the special unit, as number of staff members, is between 2 and 20, wile the number of registered participants to continuing education during the working year 2000 was between 215 and 5000 students.

In general, the percentage of short courses (less than 5 full-time days) was between 1% and 10%. The percentage of long courses (5 full-time days or more) was between 10% and 99%. The average duration of courses (in days) in the field of civil engineering was between 2.5 and 10.

In 4 universities out of 9 received answers the unit provides possibilities for distance learning: 2 on-line, 1 by mail and 1 by other means.

The financial management (incomes and expenses) of the unit is centralized at the university level in 3 institutions, decentralized (at the special unit level) in other 3, wile the university has retentions over the incomes of the special unit in 4 of the received answers.

Regarding the continuing education activities in the field of civil engineering carried by the faculties/departments, the following figures are available:

- percentage of short courses (less than 5 full-time days) between 5% and 50%;
- percentage of long courses (5 full-time days or more) between 40% and 90%;
- percentage of continuing education activities that are “tailor-made” for specific organisations from 0% up to 60%.

Organisations for which “tailor-made” activities are provided are:
- private companies – 2 answers;
- public authorities (e.g. National Road Administration, Water Resources Administration a.s.o) – 4 answers.

Regarding the framework and market for continuing education activities in the field of civil engineering, only 2 answers are showing state regulations (i.e. law, decree a.s.o.) which oblige employers, either private or public, to spend per year a certain amount of money for continuing education activities for the benefit of their employees. The weight corresponding to various driving forces behind the development of the continuing education activities in the field of civil engineering, as interest of both the employers and the employees, is between 20% and 80%.

As recognition of continuing education activities, after successfully completing the courses organised by the university, the participants receive a letter of confirmation for 3 answers, a certificate for 7 answers and a diploma for other 3 answers. In addition to these kinds of recognition, for 2 answers there is also a system of credits used in order to quantify each completed course.

The continuing education activities in the field of civil engineering undertaken at the university, either by a special unit or by faculties/departments, experience market competition for 8 of the received answers. The competitors are other universities for 5 answers and private companies providing continuing education services for 7 answers.

A rough estimate of the number of higher education institutions providing continuing education activities in the field of civil engineering either through special units or through faculties/departments in the respondent countries is between 3 and 10. Based on the activities carried out in the last three years, the percentage of sharing of the market taken by the universities is between 15% and 80%. On the other hand, in some countries the share of the market taken by construction companies, consulting bureaus, public administrations a.s.o organising “in-house” training is up to 80%.

The share of the market taken by the private companies providing continuing education services is between 5% and 20%.

The providers of continuing education in 3 universities are assessing course demand with current students. For 7 answers, surveys are conducted in order to develop programs to meet the training and education needs of companies, public authorities and other potential customers. In only one case marketing firms are used for the marketing efforts.

The providers of continuing education in respondent universities (special units or faculties/departments) are putting efforts in advertising using newspapers (5 answers), magazines (7 answers), radio (1 answer), direct mail (8 answers) and Internet (7 answers). Five universities, through their special units, participate in national networks for Continuing Education Centers.

Regarding the trends of continuing education activities in the field of civil engineering for the next 5-10 years, the respondents' opinion was as follows:

- the role of universities will be enhanced (6 answers);
- the share of the market taken by the universities will increase (4 answers).

EUCEET QUESTIONNAIRE ON POSTGRADUATE ACADEMIC STUDIES IN CIVIL ENGINEERING

0	**GENERAL INFORMATION**
	Part I Master or Master-type programmes
I.1	**ACADEMIC STRUCTURE**
I.1.1	First postgraduate degree
I.1.2	International dimension
I.1.3	Joint development of study programmes at advanced level
I.2	**DETAILS OF MASTER STUDENTS**
I.2.1	Admission Procedure
I.2.2	Number of places
I.2.3	Finance
I.3	**ACTIVITIES DURING MASTER STUDIES**
I.3.1	Course units
I.3.2	Research work
I.3.3	Other activities
I.3.4	Supervision of Postgraduate Studies
I.4	**AWARDING OF MASTER DEGREE**
I.4.1	Submission of master thesis
I.4.2	Thesis examination and degree awarding
I.4.3	Statistics on recent master studies
	Part II Doctoral studies
II.1	**ACADEMIC STRUCTURE**
II.1.1	Doctoral degree
II.1.2	International dimension
II.1.3	Intermediate qualification
II.2	**DETAILS OF DOCTORAL STUDENTS**
II.2.1	Admission procedure
II.2.2	Number of places
II.2.3	Finance
II.3	**ACTIVITIES DURING DOCTORAL STUDIES**
II.3.1	Supervision of doctoral studies
II.3.2	Course units
II.3.3	Other activities
II.4	**AWARDING OF DOCTORAL DEGREE**
II.4.1	Submission of doctoral thesis
II.4.2	Thesis examination and degree awarding
II.4.3	Statistics on recent doctorates

While filling in the questionnaire, please follow closely the accompanying guidelines where the note are explained and use the glossary and codes where needed. The answers to the questionnaire should be based on students completing their studies in either the last 5 academic years (1995/96 to 1999/00) or the last 5 calendar years (1996 to 2000).

0	**GENERAL INFORMATION**	
0.0	**Institution**	
0.0.1	Name of the institution	
	- in the language of the institution	
	- in English translation (if applicable)	
0.0.2	ERASMUS/SOCRATES code:	
0.0.3	Name of the Faculty/Department (awarding the qualification):	
0.0.4	City:	
0.0.5	Country:	
0.0.6	WWW address of Department /Faculty	
0.0.7	Does the WWW site contain information on postgraduate (Master and Doctoral) studies?	YES/NO
0.1	**Respondent**	
0.1.1	First name and surname	
0.1.2	E-mail:	
0.1.3	Telephone number:	
0.1.4	Fax number:	
0.1.5	Your position in the postgraduate programme or your job title:	

PART I. MASTER OR MASTER-TYPE PROGRAMMES

I.1 ACADEMIC STRUCTURE

I.1.1 FIRST POSTGRADUATE DEGREE

I.1.1.1 Name of the first postgraduate qualification

I.1.1.1.1	full name in the language of the institution	
I.1.1.1.2	abbreviated form (e.g. M.Sc.) if applicable	

I.1.1.2 Type of programme (please tick the corresponding type)

I.1.1.2.1	Taught Master programme	
I.1.1.2.2	Research Master programme	
I.1.1.2.3	Taught and Research Master programme	

I.1.1.3 Full time and part time studies

I.1.1.3.1	Is there the postgraduate programme in your department open only to full-time students? If YES, please proceed to I.1.1.4	YES/NO
I.1.1.3.2	What is the percentage of the total number of students enrolled as part-time students?	%

I.1.1.4 Duration of the studies

I.1.1.4.1	Is the duration of the studies for the postgraduate degree fixed by regulations? If NO, please proceed to I.1.1.5	YES/NO

		Full-time (years)	Part-time (years)
I.1.1.4.2	What is the minimum legal duration?		
I.1.1.4.3	What is the maximum legal duration?		
I.1.1.4.4	What is the typical duration of the master qualification?		

I.1.1.5	What is the typical age of the student on receiving the first postgraduate qualification without having interrupted his/her studies?		years

I.1.1.6 Number of programmes and fields covered

I.1.1.6.1	How many master or master-type programmes are offered by your department in each academic year?	
I.1.1.6.2	Please specify the fields to which the programmes belong (for instance: structures, geotechnics, hydraulics, construction management, etc.)	

I.1.2 INTERNATIONAL DIMENSION

I.1.2.1	Has the master programme in your department an international dimension, as a result of cooperation with other foreign universities? If NO, please proceed to I.1.2.4	YES/NO

I.1.2.2 Does this involve a convention between universities in

I.1.2.2.1	- several European countries?	
I.1.2.2.2	- an EU initiative?	
I.1.2.2.3	- your country and countries outside Europe?	

I.1.2.3 Which are the requirements to bring about the international dimension of the programme?

I.1.2.3.1	- part of the research work undertaken in another country	
I.1.2.3.2	- part of the course units covered by teachers from other countries	
I.1.2.3.3	- membership of the Examination Board to include at least one member from another country	
I.1.2.3.4	- part of the presentation or defence taken in another language	
I.1.2.3.5	Other requirements. Please specify	

I.1.2.4	Would there be an interest in your department to develop a master programme with international dimension?	YES/NO/POSSIBLY

I.1.2.5 Which should be the requirements for that purpose?

I.1.2.5.1	- part of the research work undertaken in another country	
I.1.2.5.2	- part of the course units covered by teachers from other countries	
I.1.2.5.3	- membership of the Examination Board to include at least one member from another country	
I.1.2.5.4	- part of the presentation or defence taken in another language	
I.1.2.5.5	Other requirements. Please specify	

I.1.2.6	In order to encourage and facilitate a master programme in civil engineering with international dimension, would you support setting up a EUCEET working group on this subject?	YES/NO

I.1.3 JOINT DEVELOPMENT OF A "STUDY PROGRAMME" AT ADVANCED (MASTER-TYPE) LEVEL (CDA)

Within the higher education Action of SOCRATES programmes entitled ERASMUS, was introduced since the academic year 1996 - 1997 a distinct activity called *"Projects for the joint development of study programmes at advanced level"*, in short CDA, as part of the Institutional Contract concluded between the University and the European Commission

I.1.3.1	Did your university develop, together with universities from at least three participating countries, a CDA project in the field of Civil Engineering? If NO, please proceed to I.1.3.5	YES/NO

I.1.3.2	Which was the title of the project?		
I.1.3.3	When did the project start and when did it finish?		
I.1.3.4	Please list the partners		

I.1.3.5	In order to take advantage of the opportunity offered by the Institutional Contract SOCRATES-ERASMUS would your faculty support the participation in one or several CDA projects in the field of Civil Engineering, following the Guidelines for Applicants, June 2000 Edition (web site: http://europa.eu.int/comm/education/socrates/erasmus/home.html)	YES/NO

I.1.3.6	In which domains of Civil Engineering would you support a CDA project? Please specify

I.2 DETAILS OF MASTER STUDENTS

I.2.1 ADMISSIONS PROCEDURE

I.2.1.1 **Entry criteria**

Enumerate by ticking all possible, appropriate entry criteria for admission to the Master programme

	Please, give your answers for each of the four categories of students.	Home	EU (15)	Other European countries	Others
I.2.1.1.1	directly after the first degree				
I.2.1.1.2	after an admission examination				
I.2.1.1.3	after the completion of an intermediate degree				
I.2.1.1.4	through a transfer when in a lower degree				
I.2.1.1.5	other (Please, specify):				

I.2.1.2 **Special entry difficulties**

When admitting students of the four categories, do special problems arise concerning (Please, tick)

I.2.1.2.1	recognition				
I.2.1.2.2	grants				
I.2.1.2.3	other (Please, specify):				

I.2.1.3 **Knowledge of the language of the country**

I.2.1.3.1	Is evidence of proficiency in the language of the country (e.g. by means of a certificate) needed? (where appropriate)				

I.2.2 NUMBER OF PLACES

I.2.2.1 **Available places** (answer by ticking)
Are the places available for master studies limited by:

I.2.2.1.1	national regulations				
I.2.2.1.2.	university regulations				
I.2.2.1.3	department/faculty regulations (resources)				
I.2.2.1.4	financial and other resources				

I.2.2.2 **The filling of available places**

	*Please, indicate by **YES** or **NO** which of the following criteria must be satisfied for admission on to a master studies programme for each of the two categories of students.*	YES/NO
I.2.2.2.1	For a student with a foreign qualification, is a recognition procedure needed?	
I.2.2.2.2	For a home student, is a satisfactory performance in a competitive examination needed?	

I.2.2.3 **Financial support**

I.2.2.3.1	Must tutorial fees be paid?	
I.2.2.3.2	Should a guaranteed subsistence be proved?	

I.2.3 FINANCE

I.2.3.1	Major source of support to cover the fee and the subsistance costs (state a rough percentage for each of the following possible sources):	(%)

I.2.3.1.1	- a home public agency (i.e. ministry of education, national or regional research council, national or regional authority, etc)	
I.2.3.1.2	- from industry (either privately or publicly owned)	
I.2.3.1.3	- by parental means	
I.2.3.1.4	- by the own means of the graduate student (i.e. through a part-time job) or other self-funded means	

I.2.3.2	May master students receive payment for contributions to undergraduate teaching?	YES/NO
	Please, specify activities:	

I.3 ACTIVITIES DURING MASTER STUDIES

I.3.1 COURSE UNITS

I.3.1.1	Do the students have to take course units during their postgraduate training toward a Master or Master-type degree? If NO, please proceed to I.3.2 If yes, please repeat the information requested at I.3.1.2 - I.3.1.5 for each of the Master/Master-type programmes offered by your department	YES/NO

I.3.1.2 Extension form

I.3.1.2.1	What is the number of contact hours spent on course units in each year	Year 1	Year 2
I.3.1.2.2	In which form are this course units offered (number of contact hours)	Year 1	Year 2
	- as specialist graduate course units		
	- as course units taken from the undergraduate programme		
	- other. Please specify:		

I.3.1.3	Are the course units assessed by examinations? If NO, please give details:	YES/NO

I.3.1.4 Credit system

I.3.1.4.1	Are the course units in your institution described by a credit system?	YES/NO
I.3.1.4.2	Is it the ECTS system? If NO, what is the relationship with ECTS? Please describe below:	YES/NO
I.3.1.4.3	How many credits are allocated to course units?	

I.3.1.5 Monitoring

I.3.1.5.1	Do you monitor the performance of the Master student taking course units?		YES/NO
I.3.1.5.2	What regulations apply in case of failure in one or more course units (please tick)	Compulsory units	Optional units
	- retake the exam		
	- take a different course unit		
	- arrange alternative activities (non course units)		
	- other. Please specify:		

I.3.2 RESEARCH WORK

I.3.2.1	Do the students have to undertake research work during their training toward getting the Master or Master-type postgraduate degree? If NO, proceed to I.3.3	YES/NO

I.3.2.2 Location of the research work outside the institution

I.3.2.2.1	May students take Master degrees while based at another location?	YES/NO
I.3.2.2.2	What is the percentage of students for which the location of the research work is outside the institution?	%
I.3.2.3	Must the subject of the research be an active research area in the department?	YES/NO
I.3.2.4	The theme of the research is normally assigned	YES/NO
I.3.2.4.1	- at the beginning of the postgraduate studies	
I.3.2.4.2	- after a specified period of coursework or preparatory training	
I.3.2.4.3	- other. Please specify:	

I.3.2.5	If to the total workload corresponding to the Master degree are assigned 100 units, what is the number of units corresponding to the research work?	
I.3.2.5.1	- less than 40	
I.3.2.5.2	- between 40 and 60	
I.3.2.5.3	- more than 60	
I.3.2.5.4	- other. Please specify:	

I.3.3 OTHER ACTIVITIES

What other activities are normally expected from the postgraduate students? Indicate (tick) for each of the following activities if that topic is compulsory (**C**), optional (**OP**) or not expected (**NE**) and indicate the number of credits (CR.Nr.)		C	OP	NE	CR. Nr.
I.3.3.1	Participation in group seminars				

I.3.3.2.	Attendance at	C	OP	NE	CR. Nr.
I.3.3.2.1	- national conferences				
I.3.3.2.2	- international conferences				
I.3.3.2.3	- intensive courses				

I.3.3.3.	Presentations of work results:	C	OP	NE	CR. Nr.
I.3.3.3.1	- in the department				
I.3.3.3.2	- at national conferences				
I.3.3.3.3	- at international conferences				
I.3.3.3.4	- other. Please specify:				

I.3.3.4	Contribution to teaching	C	OP	NE	CR. Nr.
I.3.3.4.1	- supervision of undergraduate laboratory work				
I.3.3.4.2	- tutoring undergraduate groups				
I.3.3.4.3	- tutoring undergraduate thesis work				
I.3.3.4.4	- marking of undergraduate assessments/homework				
I.3.3.4.5	- other. Please specify:				

I.3.4 SUPERVISION OF POSTGRADUATE STUDIES

I.3.4.1	Does the student need a personal supervisor during her/his activity in the postgraduate programme? If NO, proceed to I.3.	YES/NO
I.3.4.1.1	Does the same person supervise her/his Master Thesis work?	YES/NO

I.3.4.2	The thesis supervisor of a Master student can be (multiple answers are possible):	
I.3.4.2.1	- a professor in charge with a course unit from the curriculum	
I.3.4.2.2	- any professor or lecturer in the department	

I.3.4.2.3	- any researches in the department	
I.3.4.2.4	- other arrangements. Please specify:	

I.3.4.3	The thesis subject is assigned by (multiple answers are possible):	
I.3.4.3.1	- agreement between the student and the proposed supervisor	
I.3.4.3.2	- a resolution of the Scientific Board, taking into account the preferences of the students	
I.3.4.3.3	- a resolution of the Scientific Board, without taking into account the preferences of the students	
I.3.4.3.4	- other methods. Please specify:	

I.4 AWARDING OF MASTER DEGREE

I.4.1 SUBMISSION OF MASTER THESIS

I.4.1.1	Which language is normally used for the thesis?	

I.4.1.2	Are alternative languages used for the thesis?	YES/NO
	If YES, please give rough percentages for the following languages:	%
	English	
	French	
	German	
	Other (Please specify):	

I.4.1.3	Which language is normally used for the oral presentation and/or examination?	

I.4.1.4	Are alternative languages used in the oral presentation and examination?	YES/NO
	If YES, please give rough percentages for the following languages:	%
	English	
	French	
	German	
	Other (Please specify):	

I.4.1.5	Are credits allocated to the master thesis?	YES/NO

I.4.1.6	The master thesis is:

I.4.1.6.1	- a previously unpublished substantial written report	
I.4.1.6.2	- a collection of individual or co-authored scientific papers with an introduction and/or commentary	
I.4.1.6.3	- other (please, specify)	

I.4.2 THESIS EXAMINATION AND DEGREE AWARDING

I.4.2.1	Is there an oral presentation of the thesis work for an open audience as part of the assessment procedure?	YES/NO

I.4.2.2	Composition of the thesis examination board. Please, give the typical number of:
I.4.2.2.1	- internal examiners:
I.4.2.2.2	- external examiners:
I.4.2.2.3	other (e.g. independent chairperson)
	TOTAL

I.4.2.3	How is the examination board chosen? (Please, tick one box)	
I.4.2.3.1	- by the supervisor	
I.4.2.3.2	- by the scientific committee of the institution	
I.4.2.3.3	- by the academic authorities	
I.4.2.3.4	- by the national ministry	
I.4.2.3.5	- other (Please, specify):	

I.4.2.4	Do the examiners base their assessment decision on: (multiple answers are possible)	
I.4.2.4.1	- reading the thesis	
I.4.2.4.2	- the oral presentation of the thesis work	
I.4.2.4.3	- answers given to the examination board	
I.4.2.4.4	- answers given to the general audience	
I.4.2.4.5	- an oral examination of the candidate including detailed questions on the thesis	

I.4.2.5	What is the typical duration of the oral part of the thesis examination, if applicable?	hours
I.4.2.5.1	Is there an upper limit to the duration of the thesis examination? Give details.	YES/NO

I.4.2.6	Is the oral part of the examination taken behind closed doors?	YES/NO

I.4.2.7	What happens if the student fails?	
I.4.2.7.1	- may not resubmit for master degree	
I.4.2.7.2	- may resubmit revised thesis	
I.4.2.7.3	- may do further work as specified by examination board	
I.4.2.7.4	- if the thesis is to be re-submitted is there a time limit for this to occur? Please specify:	

I.4.2.8	Is there a grading system for the master degree based on the quality of the work?	YES/NO

I.4.2.9	What percentage are given the top grade?	%

I.4.3 STATISTICS ON RECENT MASTER STUDIES
(Figures based on either the last 5 academic or the last 5 calendar years)

I.4.3.1	What is the average number of master students graduating per year?	
I.4.3.2	What is the typical age of students obtaining the master degree?	
I.4.3.3	What is the percentage of female master graduates?	%

I.4.3.4	What proportion of the master graduates are from the home country?	%
I.4.3.4.1	- home country:	
I.4.3.4.2	- others	

I.4.3.5	First destination of students after completing their master (Please estimate percentages, if meaningful)	%
I.4.3.5.1	- further research work in the same or some other university (i.e. doctoral studies)	
I.4.3.5.2	- industrial research	
I.4.3.5.3	- other business employment	
I.4.3.5.4	- teaching at secondary school level	

I.4.3.5.5	- teaching at university level	
I.4.3.5.6	- other (Please specify):	

PART II. DOCTORAL STUDIES

II.1 ACADEMIC STRUCTURE

II.1.1 DOCTORAL DEGREE

II.1.1.1 Name of doctoral qualification

II.1.1.1.1	full name in the language of the institution	
II.1.1.1.2	full name in English translation (if applicable):	
II.1.1.1.3	abbreviated form (e.g. PhD) if applicable	

II.1.1.2 Type of programme (please tick the corresponding type)

II.1.1.2.1	Research Doctoral programme	
II.1.1.2.2	Taught and Research Doctoral programme	

II.1.1.3 Full time and part time doctoral studies

II.1.1.3.1	Is there the doctoral programme in your department open only to full-time students? If YES, please proceed to II.1.1.4	YES/NO
II.1.1.3.2	What is the percentage of the total number of students enroled as part-time students?	%

II.1.1.4 Duration of the doctoral studies

II.1.1.4.1	Is the duration of the doctoral studies fixed by regulations? If NO, please proceed to II.1.2.4	YES/NO

		Full-time (years)	Part-time (years)
II.1.1.4.2	What is the minimum legal duration?		
II.1.1.4.3	What is the maximum legal duration?		
II.1.1.4.4	What is the typical duration of the doctoral qualification?		

II.1.1.5	What is the typical age of the student on receiving the doctoral degree without having interrupted his/her studies?	years

II.1.2 INTERNATIONAL DIMENSION

II.1.2.1	Has the doctoral programme in your department an international dimension, as a result of cooperation with other foreign universities? If NO, please proceed to II.2.4	YES/NO

II.1.2.2 Does this involve a convention between universities in

II.1.2.2.1	- several European countries?	
II.1.2.2.2	- an EU initiative?	
II.1.2.2.3	- your country and in countries outside Europe?	

II.1.2.3 Which are the requirements to bring about the international dimension of the programme?

II.1.2.3.1	- part of the research work undertaken in another country	
II.1.2.3.2	- part of the course units covered by teachers from other countries	
II.1.2.3.3	- membership of the Examination Board to include at least one member from another country	
II.1.2.3.4	- part of the presentation or defence taken in another language	
II.1.2.3.5	Other requirements. Please specify	

II.1.2.4	Would there be an interest in your department to develop a doctoral programme with international dimension?	YES/NO/POSSIBLY

II.1.2.5 Which should be the requirements for that purpose?

II.1.2.5.1	- part of the research work undertaken in another country	
II.1.2.5.2	- part of the course units covered by teachers from other countries	

II.1.2.5.3	- membership of the Examination Board to include at least one member from another country	
II.1.2.5.4	- part of the presentation or defence taken in another language	
II.1.2.5.5	Other requirements. Please specify	

II.1.2.6	In order to encourage and facilitate a doctorate programme in civil engineering with international dimension, would you support setting up a EUCEET working group on this subject?	YES/NO

II.1.3 INTERMEDIATE QUALIFICATION

II.1.3.1	Is there an intermediate qualification between the first degree and the doctoral degree? If NO, please proceed to II.1.3.4	YES/NO
II.1.3.2	Is this intermediate qualification compulsory for the admision in the doctorate programme?	YES/NO

II.1.3.2 Name of intermediate qualification

II.1.3.2.1	full name in the language of the institution:	
II.1.3.2.2	full name in English translation (if applicable):	
II.1.3.2.3	abbreviated form (e.g. DEA, MSc) - if applicable:	

II.1.3.3 Duration of the intermediate studies

II.1.3.3.1	Is the duration of the intermediate studies fixed by regulations? If NO, please proceed to II.1.3.3.4	YES/NO

		Full-time (years)	Part-time (years)
II.1.3.3.2	What is the minimum legal duration?		
II.1.3.3.3	What is the maximum legal duration?		

II.1.3.3.4	What is the typical duration of the intermediate qualification?		

II.1.3.4	Do you wish to add any further information?	

II.2.1.1 **Entry criteria**

Enumerate by ticking all possible, appropriate entry criteria for admission to the Doctoral programme?

	Please, give your answers for each of the four categories of students.	Home	EU (15)	Other European countries	Others
II.2.1.1.1	- directly after the first degree				
II.2.1.1.2	- after an admission examination				
II.2.1.1.3	- after the completion of an intermediate degree				
II.2.1.1.4	- through a transfer when in a lower degree				
II.2.1.1.5	- other (Please, specify):				

II.2.1.2	**Special entry difficulties** When admitting students of the four categories, do special problems arise concerning (Please, tick)

II.2.1.2.1	- recognition				
II.2.1.2.2	- grants				
II.2.1.2.3	- other (Please, specify):				

II.2.1.3 **Knowledge of the language of the country**

II.2.1.3.1	Is evidence of proficiency in the language of the country (e.g. by means of a certificate) needed? (where appropriate)				

II.2.2 NUMBER OF PLACES

II.2.2.1 **Available places** (answer by ticking)
Are the places available for doctoral studies limited by:

II.2.2.1.1	- national regulations				
II.2.2.1.2	- university regulations				
II.2.2.1.3	- department/faculty regulations (resources)				
II.2.2.1.4	- financial and other resources				

II.2.2.2 **The filling of available places**

	*Please, indicate by **YES** or **NO** which of the following criteria must be satisfied for admission on to a doctoral studies programme for each of the two categories of students.*	YES/NO
II.2.2.2.1	For a foreign student, is a recognition procedure needed for his/her foreign qualification?	
II.2.2.2.2	For a home student, is a satisfactory performance in a competitive examination needed?	

II.2.2.3 **Financial support**

II.2.2.3.1	Must tutorial fees be paid?	
II.2.2.3.2	Should a guaranteed subsistence be proved?	

II.2.3 FINANCE

II.2.3.1	Major source of support to cover the fee and the subsistance costs (state a rough percentage for each of the following possible sources):	(%)

II.2.3.1.1	- a home public agency (i.e. ministry of education, national or regional research council, national or regional authority, etc)	
II.2.3.1.2	- from industry (either privately or publicly owned)	
II.2.3.1.3	- by parental means	
II.2.3.1.3	- by the own means of the graduate student (i.e. through a part-time job) or other self-funded means	

II.2.3.2	May doctoral students receive payment for contributions to undergraduate teaching?	YES/NO
	Please, specify activities:	

II.3 ACTIVITIES DURING DOCTORAL STUDIES

II.3.1 SUPERVISION OF DOCTORAL STUDIES

II.3.1.1 Location of the research work outside the institution

II.3.1.1.1	May students undertake the research work in another location?	YES/NO
II.3.1.2	Are the Doctoral studies supervised by a Scientific Board? If NO, please proceed to II.3.1.5	YES/NO
II.3.1.2.1	How many members are in the Scientific Board?	

II.3.1.3	Are the members of the Scientific Board	
II.3.1.3.1	- elected by a larger body? (e.g. Faculty, Steering Committee of the department)	
II.3.1.3.2	- appointed by the Head of the department?	
II.3.1.3.3	- chosen in another way? Please specify:	

II.3.1.4	Which are the main tasks of the Scientific Board? (multiple answers are possible)	
II.3.1.4.1	- general management of the Doctoral studies	
II.3.1.4.2	- deciding the layout of the course units, duration, etc.	
II.3.1.4.3	- advising the students on their course units options and approving their plan of studies	
II.3.1.4.4	- assigning the thesis subject	
II.3.1.4.5	- assigning the thesis supervisor	
II.3.1.4.6	- other. Please specify:	

II.3.1.5	Does the student need a personal supervisor during her/his coursework? If NO, please proceed to II.3.1.6	YES/NO
II.3.1.5.1	Does the same person supervise her/his thesis work?	

II.3.1.6	Must the subject of the Doctoral Thesis be an active research area in the department?	YES/NO

II.3.1.7	The doctoral thesis subject is normally assigned	
II.3.1.7.1	- at the beginning of the doctoral studies	
II.3.1.7.2	- after a specified period of coursework or preparatory training	
II.3.1.7.3	- other. Please specify:	

II.3.1.8	The Thesis supervisor of a Doctoral student can be (multiple answers are possible):	
II.3.1.8.1	- a professor or PhD lecturer in the department	
II.3.1.8.2	- a PhD researcher in the department	

II.3.1.8.2.1	- in this case, does there need to be a second supervisor who is a professor or PhD lecturer in the department (i.e. "co-supervisor")?	
II.3.1.8.3	- a professor or PhD researcher in another institution	

II.3.1.8.3.1	- in this case, does there need to be a second supervisor who is a professor or lecturer in the department (i.e. "co-supervisor")?	
II.3.1.8.4	- other arrangements. Please specify:	

II.3.1.9	The thesis subject is assigned by (multiple answers are possible)	
II.3.1.9.1	- agreement between the student and the proposed supervisor	
II.3.1.9.2	- a resolution of the Scientific Board, taking into account the preferences of the students	
II.3.1.9.3	- a resolution of the Scientific Board, without taking into account the preferences of the students	
II.3.1.9.4	- other methods. Please specify:	

II.3.1.9.5	- other methods. Please specify:	

II.3.2 COURSE UNITS

II.3.2.1	Do the students have to take course units during their Doctoral training? If NO, please proceed to II.3.3	YES/NO

II.3.2.2	Extension form, assessment	Nr. of contact hours			
II.3.2.2.1	What is the number of contact hours spent on course units in each year	Y1	Y2	Y3	Y4
II.3.2.2.2	In which form are this course units offered (number of contact hours)				
	- as specialist graduate course units				
	- as course units taken from the undergraduate programme				
	- other. Please specify:				

II.3.2.3	Are the course units assessed by examinations? If NO, please give details:	YES/NO

II.3.2.4 Credit system

II.3.2.4.1	Are the course units in your institution described by a credit system?	YES/NO
II.3.2.4.2	Is it the ECTS system? If NO, what is the relationship with ECTS? Please describe below:	YES/NO
II.3.2.4.3	How many credits are allocated to course units?	

II.3.2.5 Monitoring

II.3.2.5.1	Do you monitor the performance of the Doctoral student taking course units?		YES/NO
II.3.2.5.2	What regulations apply in case of failure in one or more course units (please tick)	Compulsory units	Optional units
	- retake the exam		
	- take a different course unit		
	- arrange alternative activities (non course units)		
	- other. Please specify:		

II.3.2.6 Course units outside civil engineering

II.3.2.6.1	Is it possible to take course units outside the civil engineering field? Please specify:	YES/NO
II.3.2.6.2	Can this contribute to the total credit rating?	YES/NO

II.3.3 OTHER ACTIVITIES

		C	OP	NE	CR. Nr.
What other activities are normally expected from the doctoral students? Indicate (tick) for each of the following activities if that topic is compulsory (**C**), optional (**OP**) or not expected (**NE**) and indicate the number of credits (CR.Nr.)					
II.3.3.1	Participation in group seminars				

II.3.3.2.	Attendance at	C	OP	NE	CR. Nr.
II.3.3.2.1	- national conferences				
II.3.3.2.2	- international conferences				
II.3.3.2.3	- intensive courses				

II.3.3.3.	Presentations of work results:	C	OP	NE	CR Nr.
II.3.3.3.1	- in the department				
II.3.3.3.2	- at national conferences				
II.3.3.3.3	- at international conferences				
II.3.3.3.4	- other. Please specify:				

II.3.3.4	Contribution to teaching	C	OP	NE	CR. Nr.
II.3.3.4.1	- supervision of undergraduate laboratory work				
II.3.3.4.2	- tutoring undergraduate groups				
II.3.3.4.3	- tutoring undergraduate thesis work				
II.3.3.4.4	- marking of undergraduate assessments/homework				
II.3.3.4.5	- other. Please specify:				

II.4 AWARDING OF DOCTORAL DEGREE

II.4.1 SUBMISSION OF DOCTORAL THESIS

II.4.1.1	Which language is normally used for the thesis?	

II.4.1.2	Are alternative languages used for the thesis?	YES/NO
	If YES, please give rough percentages for the following languages:	%
	English	
	French	
	German	
	Other (Please specify):	

II.4.1.3	Which language is normally used for the oral presentation and/or examination?	

II.4.1.4	Are alternative languages used in the oral presentation and examination?	YES/NO
	If YES, please give rough percentages for the following languages:	%
	English	
	French	
	German	
	Other (Please specify):	

II.4.1.5	Are credits allocated to the doctoral thesis?	YES/NO

II.4.1.6	The doctoral thesis is:	YES/NO
II.4.1.6.1	- a previously unpublished substantial written report	
II.4.1.6.2	- a collection of individual or co-authored scientific papers with an introduction and/or commentary	
II.4.1.6.3	- other (please, specify)	

II.4.2	**THESIS EXAMINATION AND DEGREE AWARDING**

II.4.2.1	Is there an oral presentation of the thesis work for an open audience as part of the assessment procedure?	YES/NO

II.4.2.2	Composition of the thesis assessment board. Please, give the typical number of:
II.4.2.2.1	- internal reviewers (assessors):
II.4.2.2.2	- external reviewers (assessors):
II.4.2.2.3	other (e.g. chairperson)
	TOTAL

II.4.2.3	How is the examination (assessment) board chosen? (multiple answers are possible)	
II.4.2.3.1	- by the supervisor	
II.4.2.3.2	- by the scientific committee of the institution	
II.4.2.3.3	- by the academic authorities	
II.4.2.3.4	- by the national ministry	
II.4.2.3.5	- other (Please, specify):	

II.4.2.4	Who has the right to vote for the admission of the thesis (multiple answers are possible)	
II.4.2.4.1	- the examination (assessment) board	
II.4.2.4.2	- the scientific committee of the department	
II.4.2.4.3	- the scientific committee of the university	
II.4.2.4.4	- other (Please, specify):	

II.4.2.5	What is the typical duration of the oral part of the thesis examination, if applicable?	hours

II.4.2.5.1	Is there an upper limit to the duration of the thesis examination? Give details.	YES/NO

II.4.2.6	Is the oral part of the examination taken behind closed doors?	YES/NO

II.4.2.7	What happens if the student fails?	
II.4.2.7.1	- may not resubmit for doctorate	
II.4.2.7.2	- may resubmit revised thesis	
II.4.2.7.3	- may do further work as specified by examination (assessment) board	
II.4.2.7.4	- may be awarded a lower level qualification (e.g. MSc)	

II.4.2.7.5	- if the thesis is to be re-submitted is there a time limit for this to occur? Please specify:	

II.4.2.8	Is there a grading system for the doctoral degree based on the quality of the work?	YES/NO
II.4.2.8.1	If the case, what percentage are given the top grade?	%

II.4.3 STATISTICS ON RECENT DOCTORATES
(Figures based on either the last 5 academic or the last 5 calendar years)

II.4.3.1	What is the average number of doctoral students graduating per year?	
II.4.3.2	What is the typical age of students obtaining the doctoral degree?	
II.4.3.3	What is the percentage of female doctoral graduates?	%

II.4.3.4	What proportion of the doctoral graduates are from the home country?	%
II.4.3.4.1	- home country:	
II.4.3.4.2	- others	

II.4.3.5	First destination of students after completing their doctorate (Please estimate percentages, if meaningful)	%
II.4.3.5.1	- further research work in the same or some other university (i.e. postdoc)	
II.4.3.5.2	- industrial research	
II.4.3.5.3	- other business employment	
II.4.3.5.4	- teaching at secondary school level	
II.4.3.5.5	- teaching at university level	
II.4.3.5.6	- other (Please specify):	

Glossary for the EUCEET questionnaires

This glossary is intended to provide a definition of the terms used in the questionnaires. Please use this meaning when completing the document, even if it has a different meaning to you.

Where a number of alternative terms are given in the glossary, the first one is the preferred term and the others are equivalents.

ASSESSMENT
The total range of written, oral and practical tests used to decide on the student's progress in the course unit or module.

BACHELORS DEGREE
FIRST DEGREE in some countries but also used for lower level qualifications. Term should be avoided, as it is open to misinterpretation.

CONTACT HOUR
A period of 60 minutes contact between a staff member with a student or group of students. Where a lecture period is in the range 45/55 minutes, it can be considered as an hour but longer periods should be converted to the equivalent number of hours.

COURSE UNIT or COURSE or MODULE
A series of lectures and tutorials or other teaching methods which is assessed by an exam or other method. This is usually associated to a number of credits.

CREDITS (see also ECTS CREDITS)
A number which specifies the size or academic value of a course unit. Usually course units totalling a specified number of credits must be passed to successfully complete a semester, academic year or degree course. A variety of credit systems exist in Europe.

CURRICULAR DEVELOPMENT PROJECTS (CDA)
Projects for the joint development of the "Study programme" at advanced (Master type) level; to be included in the institutional contract concluded between the university and the European Commission under the frame of SOCRATES-ERASMUS programme.

DEA Diplome d'Etudes Approfondies
A French intermediate degree which is normally taken by those intending to go on to a doctorate.

DEPARTMENT or Faculty
School/Faculty/Department/Division of university or research institute which provides the doctoral programme.

DOCTORAL STUDIES OR DOCTORAL PROGRAMME
Course of study leading to a DOCTORATE. There may be an alternative lower qualification for some students on the programme.

DOCTORATE OR DOCTORAL DEGREE
A high level qualification which is internationally recognised as qualifying someone for research or academic work. It will include a substantial amount of original research work, which is presented in a Thesis. For example the British/American PhD, French *Doctorat d'Etat* or the German *Dr.rer.nat*.
Note. Does not include *Habilitation* or DSc, which are normally awarded to established academics after a number of years as a Professor/Lecturer.

ECTS CREDITS (see also CREDITS)
European Community Course Credit Transfer System.
A system for comparing the workload of students across Europe, based on the allocation of 1 (legal) year of study as equal to 60 credits. This system is based on the idea that 1 years study at a European university is equivalent and should be recognised as such.

Note: This presents problems from at least two main points of view:
- a) Civil Engineering student workloads (e.g. study weeks, contact hours) are not at all similar across Europe (a factor of 2 of difference can occur)
- b) In some countries, such as Germany or Italy, the actual average duration of study considerably exceed the legal duration

EXAM
Formal written and or oral test taken at the end of a course unit or later in the academic year.
Note: Tests within the course unit are classed as continuous assessment.

FACULTY see DEPARTMENT

FIRST DEGREE OR UNDERGRADUATE DEGREE
First university qualification taken by student intending to become a professional civil engineer. Normal duration 4/5 year. (In England BSc or BEng in 3 years). This may include 2 or more steps such as the French system of DEUG, Licence and Maîtrise, which should be regarded as components of the first-degree course.

FULL TIME STUDENT
A student involved in a Master type or Doctoral programme who devotes entirely his/her working time for the fulfilment of the programme's requirements.

FURTHER STUDIES OR INTERMEDIATE STUDIES
Course of studies leading to an intermediate qualification at a level between the FIRST DEGREE and a DOCTORATE. This may be a step on the way to a doctorate or an end in itself.

GRADUATE OR POSTGRADUATE
Describing a student or a course of study leading to an INTERMEDIATE DEGREE or to a DOCTORATE.

GRANT or SCHOLARSHIP or FELLOWSHIP
Payment made to student to cover fees and/or living expenses of some or all students. From national/state/local government or charitable foundation or private company.

INTENSIVE COURSE
A short full time course of one to 4 weeks concentrating on a particular topic or technique useful for the further studies of the graduate student. This may take place at another institution and often this is a SUMMER SCHOOL.

INTERMEDIATE DEGREE OR INTERMEDIATE QUALIFICATION
A qualification taken after the FIRST DEGREE and before or possibly as an alternative to a DOCTORATE. This may involve some research work but not at a doctoral level. Examples of this are a (research) Masters degree in the UK/Ireland or the *DEA* in France.

LECTURE
Theory (basic concepts or facts) or examples class taken by a lecturer with the entire class. In this situation the students are totally passive.

MASTERS DEGREE
Either a) An intermediate degree of 1-2 years: e.g. MSc in England/Ireland
b) Name for some first degrees of 4 years: e.g. MEng in UK
This term should be used only in the first sense.

OPTIONAL COURSE
A course, which may be taken as part of a Civil engineering degree but is not compulsory for all students and is not required for later courses.

ORAL PRESENTATION
A verbal presentation to a lecturer/s and possibly other students by an individual student. This may be on a topic researched by the student in the published literature or a summary of project work undertaken.

PART-TIME STUDENT
A student involved in a Master type or Doctoral programme who is also involved in other activities and as a result devotes only part of his/her working time for the fulfilment of the programme's requirements.

POSTDOC
Term for a recently qualified researcher with a doctorate.

POSTDOCTORAL
Describing a recently qualified researcher with a doctorate who will probably be employed on a short-term contract before gaining a permanent position. Will not be registered for any further qualification.

POSTGRADUATE OR GRADUATE
Describing a student or a course of study leading to an INTERMEDIATE DEGREE or to a DOCTORATE.

RESEARCH MASTER PROGRAMME
A Master programme, which consists only in research activities to be undertaken, usually finalised in a Thesis.

RESEARCH STUDENT
A student on a RESEARCH DEGREE such as a DOCTORATE or an INTERMEDIATE DEGREE.

SCIENTIFIC BOARD
A board or committee of the department which supervises the study and progress of students on the doctoral programme. It is responsible for deciding what coursework is required in each case and may allocate the thesis topic and supervisor to each student.

SEMINAR
A class where students are required to make oral contributions to a discussion of a topic.

SUMMER SCHOOL
An INTENSIVE COURSE which takes place in the summer.

SUPERVISOR
Member of academic staff of the University who monitors the doctoral students progress, provides advice and guidance, and may be involved in assessing the thesis. This will normally be a member of the research group where the student is working but if the student is working in an outside research institute this may not be the case.

TAUGHT MASTER PROGRAMME
A Master programme which consists only on course units to be taken by the students.

THESIS
A formally presented written report, which is the basis for the award of the doctorate. This can either be a substantial written report, which is previously unpublished or a collection of published scientific papers, authored or co-authored by the doctoral student, together with a written introduction.

TUITION FEES/TUTORIAL FEE
Charges made by university to student for teaching and/or supervision, even if in some cases these are reimbursed by the government.

TYPICAL
Where typical figures are requested, this should not be the simple arithmetic average in cases where a few unusual cases will distort the figures. In such cases the most frequently found value (mode) is what is required. For example the typical graduation age may be 27, except for 1 student who completed a doctorate at 70. The value needed is 27 not the arithmetic average.

UNDERGRADUATE
Describing a student or a course of study leading to a FIRST DEGREE.

WGD - EUCEET QUESTIONNAIRE
on Continuing Education Activities in Civil Engineering

0	**GENERAL INFORMATION**	
0.0	**Institution**	
0.0.1	Name of the institution	
	- in the language of the institution	
	- in English translation (if applicable)	
0.0.2	ERASMUS/SOCRATES code :	
0.0.3	Address: Street, city	
0.0.4	Country:	
0.0.5	WWW address of the institution	
0.0.6	Does the www site contain information on continuing education activities?	Yes/No
0.1	**Respondent**	
0.1.1	First name and surname	
0.1.2	E-mail:	
0.1.3	Telephone number:	
0.1.4	Fax number:	
0.1.5	Your position in the postgraduate programme or your job title:	

I. Continuing education activities in civil engineering

I.1 Responsibility for continuing education

I.1.1 Where is the responsibility for continuing education located at your university (answer by ticking; multiple answers are possible)

I.1.1.1	A special unit of the university is responsible	
I.1.1.2	The faculties/departments are responsible	
I.1.1.3	An external organisation is responsible	
I.1.1.4	Others (please, specify)	

I.2 Special unit for continuing education

I.2.1	Name of the special unit	
	In the language of the institution	
	In English translation	
I.2.2	Year when the unit was founded	
I.2.3	The mission of the special unit is defined (please tick)	
I.2.3.1	By the university	
I.2.3.2	By the unit itself	
I.2.3.3	In co-operation between the university and the continuing education unit	
I.2.3.4	Others	
I.2.4	The teachers/trainers involved in the continuing education activities of the special unit come from (please tick; multiple answers are possible)	
I.2.4.1	The unit itself	
I.2.4.2	The faculties/departments	
I.2.4.3	External institutions	
I.2.4.4	Others (please clarify)	
I.2.5	Size of the special unit	
I.2.5.1	Number of full-time staff	
I.2.5.2	Number of registered participants during the working year 2000	
I.2.5.3	Has the special unit other responsibilities, besides providing continuing education? If yes, please specify:	Yes/No
I.2.6	Activities carried out by the special unit (in general)	
I.2.6.1	Percentage of short courses (less than 5 full-time days)	
I.2.6.2	Percentage of long courses (5 full-time days or more)	
I.2.6.3	Average duration of courses (in days)	
I.2.6.4	Does the unit provide possibilities for distance learning? If yes, how distance learning is organised	Yes/No
I.2.6.4.1	on-line	
I.2.6.4.2	by mail	
I.2.6.4.3	other (please specify)	

I.2.7	Activities carried out by the special unit in the field of civil engineering	
I.2.7.1	Does the special unit provide continuing education activities in the field of civil engineering? If yes, specify the areas covered by the activities in the year 2000 (e.g. structures, geotechnics, hydraulic engineering, construction management a.s.o)	Yes/No

I.2.7.2	Percentage of short courses (less than 5 full-time days) in the field of civil engineering	
I.2.7.3	Percentage of long courses (5 full-time days or more) in the field of civil engineering	
I.2.7.4	Average duration of courses (in days) in the field of civil engineering	
I.2.7.5	Distance learning in the field of civil engineering	
I.2.7.5.1	on-line	
I.2.7.5.2	mail	
I.2.7.5.3	others	
I.2.8	The financial management (incomes and expenses) of the unit is (please tick)	
I.2.8.1	Centralized (at the university level)	
I.2.8.2	Decentralized (at the special unit level)	
I.2.8.3	Does the university has any retention over the incomes of the special unit? If yes, please specify which % of the income:	Yes/No

I.3 Continuing education activities in the field of civil engineering carried by the faculties/departments

I.3.1	General data on the activities	
I.3.1.1	Percentage of short courses (less than 5 full-time days)	
I.3.1.2	Percentage of long courses (5 full-time days or more)	
I.3.1.3	Percentage of continuing education activities that are "tailor-made" for specific organisations	

I.3.2	Organisations for which "tailor-made" activities are provided are:	
I.3.2.1	private companies	
I.3.2.2	public authorities (e.g. National Road Administration, Water Resources Administration a.s.o)	
I.3.2.3	others (please specify)	
I.3.3	Content of activities	
I.3.3.1	Specify the areas covered by the courses offered by faculties/ departments in the year 2000 (e.g. structures, geotechnics, hydraulic engineering, construction management a.s.o)	
I.3.3.2	Give the title (name) of 3 courses offered in 2000 which enjoyed the largest audience	
I.3.4	Distance learning in the continuing education activities carried out by the faculties/ departments in the field of civil engineering	
I.3.4.1	On-line	
I.3.4.2	mail	
I.3.4.3	others	

I.4 Framework and market for continuing education activities in the field of civil engineering

I.4.1 Framework for continuing education activities

I.4.1.1	Are there in your country state regulations (i.e. law, decree a.s.o.) which oblige employers, either private or public, to spend per year a certain amount of money for continuing education activities for the benefit of their employees	Yes/No
I.4.1.2	If yes, please give the title, number and date of the regulation and provide the relevant figure specified in the regulation with respect of the amount of money to be spent for continuing education activities	
I.4.1.3	If not, please give a rough estimate, in percentage, on the weight corresponding to various driving forces behind the development of the continuing education activities in the field of civil engineering in your country	
I.4.1.3.1	The interest of the employers	
I.4.1.3.2	The interest of the employees	
	Other (please, specify)	

I.4.2 Recognition of continuing education activities

I.4.2.1	After successfully completing the continuing education course organised by your university, the participants receives (please, tick; multiple answers are possible)	
I.4.1.2.1.1	A letter of confirmation	
I.4.1.2.1.2	A certificate	
I.4.1.2.1.3	A diploma	
I.4.1.2.1.4	Other	
I.4.2.2.	In addition to the kind/s of recognition mentioned before, is there also a system of credits used in your university in order to quantify each completed course?	Yes/No
I.4.2.3	If yes, can be credits accumulated to satisfy a requirement for a degree conferred by the university?	Yes/No

I.4.3 Competition experienced

I.4.3.1	Do the continuing education activities in the field of civil engineering undertaken at your university, either by a special unit or by faculties/ departments, experience market competition?	Yes/No

I.4.3.2	If yes, who are the competitors (please tick; multiple answers are possible)	
	- other universities	
	- private companies providing continuing education services	
	- others (please specify)	

I.4.4 Providers of continuing education services in the field of civil engineering

I.4.4.1	Make a rough estimate of the number of higher education institutions in your country providing continuing education activities in the field of civil engineering either through special units or through faculties/departments	
I.4.4.2	What is, roughly, in percentage, the share of the market taken by the universities (based on the activities carried out in the last three years)	
I.4.4.3	What is, roughly, in percentage, the share of the market taken by construction companies, consulting bureaus, public administrations a.s.o organising “in-house” training (based on the activities carried out in the last three years)	
I.4.4.4	What is, roughly, in percentage the share of the market taken by the private companies providing continuing education services (based on the activities carried out in the last three years)	

I.4.5 Market research

I.4.5.1	Are providers of continuing education in your university (a special unit or faculties/departments) assessing course demand with current students	Yes/No
I.4.5.2	Is there an advisory board?	Yes/No
I.4.5.3	If yes, does the advisory board include representatives of companies, public authorities etc?	Yes/No
I.4.5.4	Are there surveys conducted in order to develop programs to meet the training and education needs of companies, public authorities and other potential customers	Yes/No
I.4.5.5	Are there marketing firms used for the marketing efforts	Yes/No

I.4.6 Advertising

I.4.6.1	Are providers of continuing education in your university (a special unit or faculties/departments) putting efforts in advertising	Yes/No
I.4.6.2	If yes, which media is used (please, tick; multiple answers are possible)	
I.4.6.2.1	Newspapers	
I.4.6.2.2	Magazines	
I.4.6.2.3	Radio	
I.4.6.2.4	Television	
I.4.6.2.5	Direct mail	
I.4.6.2.6	Internet	

I.5 Networking

I.5.1	Does your university, through a special unit, participate in national networks for Continuing Education Centres?	Yes/No
I.5.1.1	If yes, which?	
I.5.2	Does your university, through a special unit, participate in international networks for Continuing Education Centres?	Yes/No
I.5.2.1	If yes, which	

I.6 Trends

I.6.1	In your opinion, what are in your country the trends concerning continuing education activities in the field of civil engineering for the next 5-10 years	
I.6.1.1	The role of universities will be enhanced	Yes/No
I.6.1.2	The share of the market taken by the universities will increase	Yes/No
I.6.2	In your opinion, what are in your university the trends concerning continuing education activities in the field of civil engineering for the next 5-10 years (please, tick)	
I.6.2.1	Activities will increase	
I.6.2.2	Activities will remain at the present level	
I.6.2.3	Activities will decrease	

PART THREE

REPORT OF THE
WORKING GROUP E

Innovation in Teaching and Learning in Civil Engineering Education

Synthesis of Activities Undertaken by the Working Group E

Balance and Change in Civil Engineering Education

Patrick HOLMES
Imperial College London (UK)
Demos ANGELIDES
Aristotle University of Thessaloniki (GR)
Eivind BRATTELAND
Norwegian University of Science and Technology (NO)
Leal LEMOS
University of Coimbra (PT)

SYNTHESIS OF ACTIVITIES UNDERTAKEN BY THE WORKING GROUP E

1. Terms of Reference of Working Group E

The EUCEET Steering Committee stated that:

“The Major work of Working Group E is to identify and disseminate best practise in teaching and learning in civil engineering education”

It also stated that “A special goal of Working Group E will be to prepare a debate on the range of skills a civil engineering graduate for the 21st century will need and on the educational methods to be used for equipping students with such skills”.

2. Working Method:

In order to tackle this broad and complex topic the work of the Group was divided into three sections:

“*Attitudes and Skills Learning*” - Chaired by Professor Luis Leal Lemos, University of Coimbra, Portugal.

”*Teaching and Learning Methods, including Information Technology in Support of Learning*” – Chaired by Professor Demos Angelides, Aristotle University of Thessaloniki, Greece.

“*Balance in Civil Engineering Degrees and Diplomas, in the Context of Changes in the Profession*” – Chaired by Professor Eivind Bratteland, Norwegian University of Science and Technology, Trondheim, Norway.

Following a preliminary discussion of the mandate of Working Group E at the EUCEET Meeting in Odense, Denmark, 17th –19th May 2000, two meetings were held to allow each subgroup to make progress in its own work and also, in plenary sessions, to inform all members of the Working Group of the progress of each Subgroup. This allowed cross-fertilisation of ideas and kept duplication of effort to a minimum. Members of the Working Group who were unable to attend these meetings were able to make an input into the work of the subgroups by electronic mail, via the Chairmen of the subgroups.

All members of the working party express their thanks to colleagues who organised these meeting locally and for the support given to those meeting by each university:

Aristotle University of Thessaloniki, 19th – 21st October 2000

Norwegian University of Science and Technology, 2nd – 4th November 2001

3. Membership of Working Group E

Chairman: **Professor Patrick Holmes**, Imperial College, London, United Kingdom.

Subgroup 1.

Chairman: **Professor Luis Leal Lemos**, University of Coimbra, Portugal.
Assoc. Prof. **Gerhard Barmen**, Lunds Tekniska Hogskola, Sweden.
Professor Joao Paulo Castro Gomes, University of Beria Interior, Portugal.
Professor Manfred Federau, Engineering College Odense, Denmark.
Professor Ghislain Fonder, University of Liege, Belgium.
Professor José-Luis Juan-Aracil, Esc.Tecn.Sup.Ing. de Caminos, Madrid, Spain.
Brendan Keenan, ENTPE, Vaulx en Velin, France.
Professor Alan Kwan, University of Wales Cardiff, Wales.
Professor Jose Ferreira Lemos, Universidade do Porto, Portugal.
Professor Jean Paul Mizzi, ENTPE, Vaulx en Velin, France.
Assoc. Prof Juris Rihards Naudzuns, Riga Technical University, Latvia.
Dipl.-Ing. **Carolin Trinks**, Technische Universtät Dresden, Germany.
Helena Wasmus, University of Technology Delft, Holland.

Subgroup 2.

Chairman: **Professor Demos Angelides**, Aristotle University of Thessaloniki, Greece.
Assoc. Prof. Istvan Bodi, Budapest University of Technology and Economics, Hungary.
Professor Ban Seng Choo, University of Nottingham, United Kingdom.
Prof. Matej Fischinger, University of Ljubljana, Slovenia
Prof. Wojciech Gilewski, Warsaw University of Technology, Poland.
Dipl.-Ing. Ralf Reinecke, Technische Universität München, Germany.
Goran Sallfors, Chalmers University of Technology, Sweden.
Bruno Tassin, ENPC, Marne la Vallée, France.

Subgroup 3.
Chairman: Professor Eivind Bratteland, Nowegian University of Science and Technology, Norway.
Professor Iuliu Dimoiu, Politechnica University Timisoara, Romania.
Professor Patrick Holmes, Imperial College, London, United Kingdom.
Professor Júlia Lourenço, Universidade do Minho, Portugal.
Professor Dan Stematiu, Technical University Civil Engineering Bucharest, Romania.
Professor Elzbieta Urbanska-Galewska, Technical University Gdansk, Poland.

4. Acknowledgements

The writers would like most sincerely to acknowledge the contributions of all members of Working Group "E and other colleagues who made helpful contributions. Their input in written form and in extensive discussions is much appreciated and has greatly helped the preparation of the report "*Balance and Change in Civil Engineering Education*". Any errors and omissions are those of the writers.

BALANCE AND CHANGE IN CIVIL ENGINEERING EDUCATION

1. Changes in a Global and Professional Context

1.1 Introduction

Education can be defined as: ”**the attitude of mind which remains when one has forgotten everything one has learned**”, an attitude which is expressed by the application of a number of basic and, importantly, transportable skills. It is the function of civil engineering education to provide the best context in which students can educate themselves in the development of these skills, coupled with understanding of physical and social processes which are important to the practise of the profession.

This report attempts to view the existing educational provision in civil engineering in Europe. This is in a context of a rapidly changing world with new demands being placed on professional engineers in their function of providing the essential infrastructure of everyday life. It also considers new ways and means of delivering civil engineering education, aimed at continuously improving the context and effectiveness of that education.

1.2 General Global Trends

Civil engineering provides the majority of the infrastructure and significant parts of the public and private facilities that are used in our day to day lives. Hence, most of the general global trends will have significant impacts in the field of civil engineering.

The growing world population, from 6 billion to 10 billion people by the year 2050, together with technological developments, are the most important causes for a number of developments and challenges:

- There is a strong and rapidly increasing pressure on food and fresh water supplies, we are using, and gradually using up, many of the non-renewable resources available on the planet. Sustainability is the key word and at present the actions of mankind are far from establishing a sustainable planet.
- Urban developments are escalating, the expanding population creates housing and infrastructure challenges, including the enormous problem of dealing with waste; maintenance of these facilities is often delayed and/or neglected, with serious consequences.
- Transportation demands are increasing significantly for both cargo and people. Shortages of natural resources are becoming a limiting factor in certain areas of the world; heavily populated regions are experiencing a serious lack of space that gives rise to demands for new solutions.

- Man-made activities and functions are influencing the environment on local, regional and global levels; natural disasters and climate change - whether man-made or due to nature's own fluctuations - seem to be increasing.
- There are growing concerns for safety and demands for a clear identification of risks associated with normal living.

Technical developments have provided means to link people and nations closer together, physically as well as in a communication sense. Information and communication technology have exploded over the last decade, providing extremely powerful tools and transforming society. Changes are developed and implemented at a rate which was unheard of just ten to fifteen years ago. We are becoming "globalised", yet strongly influenced by local and regional decisions and conditions. Globalisation is noticeable in virtually all aspects of society: exploitation and use of natural resources, production and markets, travelling, human resources, technology, cultural and social knowledge and understanding, etc. The concept of sustainable development is gradually (although very slowly) being implemented, aiming at providing a sound basis for future generations. In this context, "sustainability calls for civil engineers to be leaders".[1]

Productivity in general industry has increased steadily over the last 25 years. Unfortunately this is not the case for civil engineering construction. Reference 1 states that "There has been a decline in productivity in the construction sector by 0.5% a year from 1964 to 1998, while other industrial productivity increased by 1.7% annually."[1] Civil engineering work has an inherently high degree of complexity, where non-engineering issues dealing with social, political, economic and environmental concerns have become far more important than previously. Additionally, most civil engineering projects are unique and have a long design life, in contrast with the short lifetimes/early obsolescence of many manufactured products. This creates a demand for design, which allows enhancement of capacity at a later stage; the alternative is demolition. At the same time, in many areas, civil engineering has become a symbol of an activity creating environmental problems rather than a tool for solving these challenges. This might be mainly related to lack of public understanding of the role of civil engineering in relation to other fields, and to lack of communication skills and involvement in decision making processes by civil engineers who seem prepared simply to execute the decisions of others.

New technologies are generally not developed within the field of civil engineering. Therefore, civil engineering must adopt to a situation where other fields are advancing and developing faster, and we must strive to apply new and "unknown" technologies in our work and to our advantage. These and other factors have resulted in lowering the prestige, image and influence of civil engineers.[2]

1.3 University Response

In recent years universities world-wide have tended to become more and more dependent on an increasing volume of external funds. The extension of academic contacts with the profession is beneficial, on the other hand it might narrow research activities to a small band of interest. This development has put pressure - and many feel resulted in un-wanted impact - on time available and allocated to teaching efforts, this in a context where teaching excellence is not readily recognised in relation to promotion. At the same time, the demand for economic efficiency has created pressures on the universities to provide engineers who can be productive in their respective companies as quickly as possible. In most areas, a longer in-house training period for new graduates has been accepted in most companies leading to extensive developments in life-long learning.[3] The latter imposes an additional responsibility on universities in educating students in their capacity to undertake life-long learning. For this reason and in terms of effectiveness of university education, considerable attention is given later in this report to learning methods and styles.

1.3.1 Developments in Civil Engineering Education

Civil engineering education basically deals with the transfer of theoretical knowledge to engineering application. Relative to other engineering fields, civil engineering is unique - in that we generally solve “one of a kind” problems. Technical developments and the growing complexity of projects have generated strong pressures on the number of subjects to be given in university civil engineering courses, and on the volume/content in each component of those courses. The amount of technical material presented in each class has increased significantly in the last twenty years.[3]

It is thus quite clear that: “ ...the volume of information that engineers are collectively called upon to know is increasing far more rapidly than the ability of engineering curricula to cover it”.[4]

Curriculum developments are a delicate balance between keeping up the necessary “fundamentals”, represented by mathematics, basic sciences and core engineering subjects, and their “applications” in engineering design projects and products. In this development care must be taken to avoid extreme pendulum effects resulting in over-exposure to one part of the study. In this process the emphasis on ability to reproduce factual information has gradually been reduced, to the benefit of more focus on basic understanding and ability to make use of knowledge in a design context.

The rapid changes, and the sheer volume of information needed and available have encouraged an increased focus on the concept of lifelong learning in education. It becomes imperative to “learn how to learn”. The “need to know” is being replaced by the “need to know where to find”. With this the students will be more able to adapt to changes and handle new challenges.

The “new” functions and roles of the civil engineer in the public arena, corresponding to and reflecting general global trends, require changes in the traditional curricula. Communication must be extended to include non-technical issues and inter-personal skills as well; team-work and use of wide networks are, more often than not, an imperative part of the process. Design problems are increasingly complex and comprise input and assessment over a broad range of fields, combined to produce an “optimal” solution that will be acceptable for all parties involved.

One approach to the needed changes is to reduce the compulsory course part of the traditional curriculum model and to develop different areas of specialization fields where students can select from a wide range of elective subjects. Another approach is to enhance the volume and integration of engineering design subjects into a synthesizing design process, where students often work in teams, sometimes even in a multi-disciplinary system. To foster the understanding of physical processes, it is commonly accepted that fairly extensive laboratory work is an important input in the process. Unfortunately, laboratory work normally calls for extensive resource inputs both in time and money, and funding restrictions imposed on universities have resulted an opposite trend, a reduction in the volume of laboratory study work. In a context of pressure to “make (and/or save) money”, laboratory activities tend to lose relative to other demands.

Knowledge and understanding of environmental processes and conditions to meet the global need for focus and efforts are handled in different ways. Some institutions are developing specialized environmental study programs, while others work on integrating the environmental aspects into virtually all civil engineering subjects. The increased complexity of practical projects, together with the broader interest from the society and the public, call for an increased involvement of students in teams representing a variety of interests as owners, designers, contractors, public authorities, etc. For larger projects this will develop into huge project organizations, where effective project management becomes an extremely important part of the whole process.

In summary “...the civil engineer of the next millennium must be educated differently than in the past”.[1]

1.3.2 The Present Situation

“Too often engineering is viewed as “technical” and somewhat separate from our “culture”.[1] This statement pinpoints the push towards including more non-technical (social) subjects in civil engineering curricula. These social skills can probably be more effectively taught by integrating them within the core engineering subjects, particularly in engineering design subjects. Experience seems justify a profoundly sceptical attitude towards the effectiveness of teaching “social skill” subjects separately.

The civil engineer of to-day must acquire an understanding of new and demanding subjects to be able to meet future challenges in civil engineering projects. In this context subjects as information technology, new and advanced materials, biology, and management techniques etc, are all very important.[17]

Changes in learning styles from the traditional lecture concept towards various degrees of concurrent, collaborative and problem-based learning are underway. New tools and means to handle enormous amounts of information are available, and networking of the participants in a project will be put into more efficient use.

1.3.3 Examples of Development

Development trends over the last 20 - 35 years are given for four different universities in Appendix 1. Universities have different structures and study programmes which evolve at different rates over time. This makes direct comparison difficult but the input given in Appendix 1 and extensive discussions in the Working Group provide the basis for the following general statements:

- Mathematics and basic sciences content of courses seem to have remained constant over the last 20 - 35 years. If anything there might be a slight increase. As percentage over the whole study period the range of 20 - 25 % is typical.
- A trend towards a reduction of core engineering subjects and an increase in applied or specialized engineering subjects is observed. 20 - 30 % of the study time is typically devoted to core engineering subjects.
- Applied or specialization subjects in civil engineering have been provided mainly by means of optional courses and large variations exist between universities. Depending on study programmes, structure and layout, some 15 - 45 % of a student's study time could be allocated to these subjects.
- Humanities, social sciences and economics show an increase in volume. (with a marked difference for the East-European countries related to changes in compulsory political studies). There is an increasing trend in the provision of non-technical subjects.
- Percentages of optional subjects vary widely over time and between universities, linked to changes in study programmes and study layout.

1.4 Directions of Change

Changes in Civil Engineering education are imminent and take place relentlessly, influenced by global changes in society, technology and the changing role of civil engineering. The so-called "Bologna Declaration" recommends the award, after three years, of a first degree for "marketable" engineers. The splitting of a five year curriculum, into a 3+2 system appears difficult for many universities and no coherent proposal has been agreed upon so far. It is strongly felt in the academic world that changes should result from an evolution rather than a revolution.

To identify the driving forces and direction of change in Civil Engineering, education must be identified and consider in a broad context. To look for the optimum direction of change it is necessary to define the desirable end result:

- what "end product" of our educational efforts is demanded by society and industry?
- what, as a consequence, are the required "methods of production" and measures to be taken?[1]
- at the same time, what are the objective conditions/situation/environment we have to work within and the limitations imposed?

Changes in any system reflect the pressures from, and interaction with, other systems. Pressures on Civil Engineering education are both external and internal:

a) External (From outside the Civil Engineering education sector)

- From society – to provide well-educated and efficient graduates who contribute to sustainability at reasonable public expense;
- From industry and the profession – demanding staff capable of drawing together knowledge and skills from different areas and able to solve open-end problems;
- From legislatures – to improve the quality of the engineering programs (ABET evaluation criteria);
- From secondary education – the quality of input (first year students) is different in terms of knowledge of mathematics and other basic sciences; the attitudes of those students have changed markedly. Thus the baseline from where a Civil Engineering course starts has changed;
- From other branches of engineering – funds for R&D are pouring into fields outside Civil Engineering, thus attracting the most talented young people; the number of applicants for Civil Engineering courses is declining;
- From non-university educational and training services – "e-learning" based on the Internet offers much cheaper and flexible alternative to conventional

lecture-hall education, an alternative that overcomes time and space limitations and erodes progressively the market share of the universities.

b) Internal (from within the Civil Engineering education sector)

- From old/outdated paradigms and delivery methods;
- Conservatism of the professorate;
- Time allocated to research versus teaching and consulting, linked to promotion;

Some of the weak points of the current Civil Engineering education can be identified as:

- Fragmentation (subjects usually not taught as a part of the whole, links among them broken)
- Too "technical" and isolated from other engineering and non-engineering fields
- Does not foster enough creativity, independent learning and critical thinking
- Too routine, boring and not attracting its share of the brightest young people (aren't we producing engineers that feel themselves "*just another brick in the wall" (Pink Floyd)*?)
- Slow in responding to global issues and impacts

1.4.1 Student Skills on Entry

For some time now, **students have entered the universities with reduced basic theoretical skills,** definitely so in mathematics and probably also so in physics and chemistry. Gradually, this is being recognized by society, and people in political and governmental sectors are focussing on developing these subjects, as well as getting more young people interested. However, we will certainly not go back to "good old days". Still, the students entering the universities will lack basic knowledge and understanding, their skills are more likely to be related to applied knowledge on how to use the basic subjects in solving specified issues. This is a very important challenge for the universities to face, and to relate this to the needs for understanding in basic theoretical subjects that can be used for all the variety of problems encountered in the modern society.

On the other hand, most new students entering the university have developed significant proficiency in computer use. The existence of new tools should have an influence about the way mathematics and basic sciences are taught. However, it is essential to retain key elements: the careful statement of assumptions and the deductive process are part of the engineering culture. It is wasteful of time to teach all the tricks to solve special sets of differential equations and calculate integrals: computer methods and integral tables will do the job. The emphasis should be on numerical analysis, making students aware of the limitations or the restrictions in using computer methods. Numerical models are only numerical *models*!

1.4.2 Numerical modelling

Numerical modelling has developed to a level where "most" day to day problems can be solved by some already available model. One of the most important challenges for the universities is to provide future professionals with the knowledge and understanding needed for avoiding misuse of such models, with possibly far-reaching impacts. Numerical models are splendid tools, but must be used in a setting where the users know the physics of the problem, and understand the limitations of the models. Courses that use software packages only to facilitate calculations contribute little to acquiring modelling skills, and instead, these are developed in ad hoc fashion during the early years of practice. The desired direction of change from the current status/situation could be in departing from the tradition of teaching structural mechanics and structures separately towards integrated design courses in which modelling and numerical simulations are the missing link between the above (various) components.

1.4.3 Physical Understanding and Laboratories

Physical understanding is a key to engineering. Students of engineering should develop a feeling about "how things work". In this context, use of **laboratories** is extremely important. Funding conditions in universities have reduced the laboratory part of the studies. If we are going to meet the future, this trend must be reversed. Acceptance of increased use of laboratories, by society, politicians and funding bodies, is imperative for providing civil engineering undergraduates with the necessary understanding of physical processes.

Numerical simulations are considered as a modern alternative to experiments. Indeed, the power of available computers and software should enable students to "test" numerous options. In particular, a large number of "what if" situations can be explored. The best of both worlds is obtained when experiments and numerical simulations can be conducted in parallel.

Society is moving in a **practical, applied direction.** It is the responsibility of universities to meet this demand, still maintaining the basic knowledge level, and the physical understanding of the complex problems encountered in the real world. We should develop not only creative, but also constructively critical students.

1.4.4 Globalisation and Internationalisation

Globalisation and internationalisation will only increase. Therefore, future engineers must develop an ability to develop understanding across national borders. This must be based on a reasonable common understanding of basics. Increased international exposure and contacts are extremely important in this respect.

Construction projects are becoming more and more **complex**, and the traditional technical issues can no longer be viewed separately; they must be put into a **broad framework context** related to political, societal, social, economical, cultural, … etc conditions. This requires an understanding of the engineering of other disciplines, where the linkages and relations to non-technical subjects must be appreciated. However, care must be taken over the degree and level of knowledge required in these other subjects.

Based on the actual and foreseeable situation for the universities, it seems obvious that the students **need to accept their own responsibility for learning**. An encouraging observation in this respect is that students are concerned whether they are "learning enough" by the new teaching methods, as compared to the more traditional ones.

1.4.5 The Information Explosion

Information will be there in the future - in abundance. Seeking the right information and using this for specific purposes is already a routine procedure. Using information without knowledge and understanding is potentially dangerous. Hence, there is a balance between knowing how to find information and understanding the physics and the phenomenon involved in the problem at hand. Do we have a situation today where the gathering of information is over-emphasised relative to the focus on physical understanding? If so, what could be done with this?

1.5 Changing the Education Process

How are we teaching, and what results are we achieving? Are we producing engineers ready to meet the future challenges in a best possible way? These are very important questions, still keeping in mind that there is no unique, optimum way that can be easily defined. To foster a better grip on directions of changes and to get an active tool for making necessary adjustments and changes, **quality assessment** methods and procedures must be developed further. Good and applicable "uniform", international methods and procedures would assist in assessing our own teaching relative to others and relative to the demands. It is important that quality assessment includes an evaluation of "skills learned" or "learning outcomes", factors that must be applied to every learning experience in a degree/diploma course.

In introducing changes, the balance issue is extremely important:

- Fundamentals vs. applications (balance in curricula)
- Compulsory vs. elective
- Knowledge vs. skills and attitudes
- Technical skills vs. social skills
- Variety of teaching methods (balance in teaching and learning, teacher-centered vs. student-centered, cooperative vs. individual learning)
- Teaching vs. research (balance in staff activities)

1.6 Changes in Options and Choice – Changes in core subjects

The explosion of knowledge has led some academics to think about a six year curriculum; the idea was soon abandoned: why six years and not seven when science has expanded more? It is impossible to teach everything an engineer should know understand and, even if it was feasible, that knowledge and understanding would soon become obsolete. Note that we differentiate between "knowledge" (the remembering of factual information) and "understanding". In recent years the requirement for the former has steadily been reduced in civil engineering courses, and, of course, human memory is not accurate enough for civil engineering applications.

Teaching must first concentrate on the core subjects of civil engineering: strength of materials, structural mechanics, soil mechanics, fluid mechanics, essentials of steel, concrete and post-tensioned concrete construction, notions of environmental engineering, … the essential "core" of the early years of study.

Later years should aim at several objectives: specialization, social learning and internationalisation. Civil engineering departments in all universities usually have a number of strong points, for instance, steel construction and hydraulics, or environment and concrete construction. Specialized courses in these subjects could be organized, in the form of modules or groups of courses. The objective would be not so much to specialize the students, although it would be a secondary effect, as for them to experience studying at an advanced intellectual level. Many academic staff carry out research at the leading edge of their specialisations and are therefore ideally placed to take students to significantly higher intellectual levels. It is noted that, albeit with the limited data available to the Working Party, relatively small option course (electives) choice is given to students in many universities, generally less than 10% of their course, with an exception at Imperial College of over 37%.

If students feel attracted by a field that is not offered, it is a good motivation to go abroad and spend a few weeks, months or a full year in a university that is renowned in this particular field.

In existing "year abroad" schemes the subjects studied by the student at his/her host university, compared with those that would have been taken at his/her home university, are considered to be much less important than the intellectual level demanded by the subjects they do study when abroad.

This modular organisation and a good reputation in a particular field attracts able foreign students for a limited period of time, up to one year, contributing to the internationalisation of the institution. Most importantly, such an exchange contributes greatly to the students' experience and attitude development. This is the reason why students who have studied in different countries are in such demand by the profession.

Social aspects are more difficult to cover. It is clear that students are not motivated by non-technical courses sprinkled over the curriculum. To gather all these courses in the final year of a course is not successful; they are perceived as an afterthought : "Oh, by the way, we forgot to teach you a few facts of life!"

Experience in the profession during a students' university career, a minimum of several months, is certainly most useful, not only from the technical point of view but also for social learning.

There have, in recent years, been some notable developments in Problem Based Learning, PBL. Some colleagues consider that it should be practiced in the final year, when it offers the opportunity to synthesize elements of civil engineering from previous years of study. Some proponents of PBL prefer to practice this system in the first year, as at Trondheim. The purpose is then different: to acquire a method of learning. It is important with such a deconstructed system of teaching that the potential gaps that might result in the formation are recognised and compensated for, an essential part of the design of PBL. If students are conscious of these gaps and can profit from the newly acquired methods of learning to fill them, then there is a clear benefit. Problem Based Learning in peer groups, as practiced in Lyon and Trondheim, is clearly good for motivation. But it is not that easy to set up, it can be demanding on resources and is not sufficient on its own.

Problem based learning is somewhat practiced during the final project, when a student is left alone with a problem to solve and receives a minimum of guidance from a supervisor: The student has to find what information is needed, where to find it (be it in the library, in the laboratory, or from some competent person), how to assimilate and use it. He also has to communicate his results in a significant report and present them during an oral presentation.

1.7 Summary

The key elements arising from obvious changes in the context of the civil engineering profession are:

- Speed of change and students' ability to cope with it – via transportable skills and continued (life-long) learning.
- Complexity of projects within the profession and students' capacity to work within a team (often interdisciplinary) with good communication skills.
- Wider impacts of all civil engineering projects – social, economic, environmental….. and students' experience and vision to perceive these needs and to manage them effectively.

Given these main conclusions the essential consequence is to review the evolution in civil engineering courses to provide an optimum learning experience for the students. It is noted that such an evolution is essentially internal to universities but is increasingly being demanded from outside, by the profession, by education funding systems and by society itself.

2. Attitudes and Skills

2.1 Introduction

Teachers tend to teach the way they were taught. The fact that they are now teaching indicates that they were very successful at learning and therefore, understandably, to their mind the way they learned is the way to teach. In this way teaching is self perpetuating and in many institutions the modes of teaching have not evolved much over the last decades. The system has considerable inertia!

However, when one looks at the various boards of accreditation for engineering courses and notes that these accreditation boards reflect, more in a reactive as opposed to proactive sense, the needs of industry, one can conclude that the profession of engineers is not changing but has changed and is not short of new challenges in the future.

For example, the Accreditation Board, Engineering and Technology ABET (USA) http://www.abet.org suggests that to better prepare their entry to industry, graduates not only need a firm grasp of science, maths and engineering fundamentals but also multidisciplinary teamwork skills, lifelong learning skills and an awareness of social and ethical considerations.

The Institute of Engineers of Ireland lists the following among its criteria for accreditation in their document of May 2000 http://www.iei.ie/career/prog.html :

- Significant individual project work.
- Appreciation of ethical, legal, management, commercial and industrial practice.
- Health and Safety.
- Industrial, social and environmental impact of engineering.
- Sustainable technology and development.
- Development of communication and presentation skills.
- Opportunities to learn a foreign language.

Rugarcia et al [1] suggest that for engineers to meet the challenges of the future the following skills are necessary:

- Independent, interdependent and lifetime learning skills
- Problem solving, critical thinking and creative thinking skills
- Interpersonal and teamwork skills
- Communication skills
- Self assessment skills
- Integrative and global thinking skills
- Change management skills.

To add to this *La Commission des Titres d'Ingénieurs (Fr)* 1998, the French accreditation board, also lays heavy emphasis on the mastery of foreign languages and notes that international recognition for engineering schools depends on:

- Mastery of Languages
- Student Exchanges
- Foreign Partnerships
- Double Diplomas

The *Comité d'Etudes sur les Formations d'Ingenieurs* rightly points out that although foreign languages are important for graduates working in an international context, errors in languages are more acceptable than errors in cultural exchanges and company culture.

In summary, therefore, today's graduates not only need to have extensive knowledge in engineering fundamentals but also need to be able to perceive what they do not know and should possess the skills necessary to extract this information from others. The image of the engineer working in contented isolation is no longer relevant.

First year students at the ENTPE, a well known French Grande Ecole, have a week's work placement shadowing an engineer in the field. It is interesting to note how they see the profession when they come back. Deliberately, they are given little preparation for this work placement. Before leaving they imagine an engineer working alone over a blueprint to come up with *the* solution and when they come back to school they talk about running meetings, public speaking, human resource management, being good on the phone, negotiating etc.

The main objective of a university degree/diploma is to provide the optimum context in which students can educate themselves, learn to learn. The difficulty is that this has to be carried out in a subject that is rapidly widening and deepening so, as indicated previously, selectivity in topics studied is essential provided that whatever choices students may make there remains the opportunity for them to acquire the requisite, key, transportable skills needed in the civil engineering profession.

Any educational process must begin with the ”raw material” and therefore student attitudes and skills-base on entry to a civil engineering course are critical.

2.2 Learning Skills – Characteristics of the Modern Student on Entry to University

2.2.1 The Traditional Approach – Teaching, Learn if you Can!

The traditional approach in universities is that teachers teach and *therefore* students learn. Learning is thus often considered to be a student concern and not a teacher issue, and hence the teacher does not need to get involved in the learning process. There has also been a notion that, given a well motivated student of the right academic calibre, high quality teaching will result in high quality learning. Consequently, many education audits examine issues such as the standard of the students on entry (generally judged by examination results only), the facilities and the level of learning support (e.g. laboratories and libraries), and the quality of teaching as measured through direct observation. All of these important features are on the side of provision in the teaching-learning process, and the inference is that quality learning, which is the actual output of interest, will result when there is quality provision.

The implied causal link between teaching and learning is known to be weak, and it is therefore essential that teaching and learning are matters of concern for students *and* teachers. Teachers need to engage themselves in the learning process as much as they run the teaching process. Furthermore, students need to participate in shaping the teaching process by providing meaningful feedback to teachers so that the teaching process can be influenced proactively. The teaching and learning process is thus not so much a knowledge transfer mechanism, but a “symbiotic” exercise in which both the students and teachers learn and teach. This can only come about when the teacher is engaged in the students' learning process, and is willing and able to offer more than merely information delivery. The teacher's ultimate aim should therefore not merely be delivery of high quality teaching, but to bring about high quality learning in the students.

2.2.2. Learning Skills

It is often the case that learning skills are not discussed or reviewed when a student enrols on a university course. The student is usually unaware of what learning skills are, what learning skills are expected of him or her, and whether he or she possesses any of these skills and to what extent. Students are assumed to be professional learners by the time they reach university. It is also assumed that if students were deficient in some undefined learning skills required for university learning, then they would eventually automatically rectify the situation through participating in the academic process. It is also often the case that institutions lack clear documentation on policies on teaching, learning and assessment methods and hence while students are told "what" are expected of them, they often have to make their own judgment on "why". For example, few lecturers actually explain the purpose of their lectures but students are expected to understand how lectures and taking notes at lectures would enhance their learning. Since students come from widely different backgrounds and have different characteristics, the result is a wide range of (often poor) understanding of the teaching and learning processes in which they engage.

If the teacher is to play an active role in facilitating student learning, then it is absolutely critical that he or she understands something of the characteristics of the student. In general, the teacher makes an assumption of the "typical" student in the class, and proceeds with the course. This initial assumption is often based only on the academic ability of the student which itself might not be verified until the final assessment of the module or course unit. It is argued that such an approach dissociates the teacher from the learning process, and can deliver a poor learning environment, on two counts. Firstly, the majority of the student might have academic abilities that are quite different from the assumed "typical student" and, secondly, learning is governed by a range of parameters of which academic ability is only one. It is essential that the teacher must understand better the characteristics of the students in order to facilitate learning.

Students are expected to be resourceful, self-motivated, hard-working, and independent learners, and if they are not so at the beginning, then it is assumed that these students will gain these qualities through being part of the university system. However, many students arrive at university through an examination system which does not evaluate these attributes. In particular, students are dependent learners based on their school education – they need to become independent learners, not only for their university careers but also in their professional lives which demand largely independent continuing education.

Very few university departments conduct diagnostic assessments to find out what the student is actually like, there may even be no diagnostic assessment facility available even if teachers want to use one. There seem to be few diagnostic systems design for university use, in contrast to many that are used regularly in the profession.

The traditional teacher is primarily concerned with academic issues and thus makes adjustment typically through the academic context. The characteristics of the student is often judged through the characteristics displayed by the student towards his/her academic studies. For example, where a student does not display much perseverance in trying to solve a tutorial problem, he or she is diagnosed as having a lack of perseverance, whereas the same student might actually display tremendous perseverance in another activity (in physical training to excel in a sport). Students might thus have latent attitudes and skills highly useful for effective learning which are not enabled in the academic context, for whatever reasons. For example, the students might need be reward-driven and the lack of any perceived reward for answering a tutorial question ("I cannot see what I get out of it") might actually cause the student to give up prematurely. If the teacher understands the characteristics of the students, and is able to create the necessary learning environment to bring these latent attitudes and learning skills to the fore, then the teacher has been proactive in the learning sphere and enhanced student learning. A major mechanism which promotes these attitudes in academic staff is to require a statement of objectives and expected learning outcomes (understanding and skills) to be provided to the students for all courses they take and to invite their comments on the extent to which these objectives and learning outcomes were achieved. This approach has already been adopted in some universities.

2.3 The Modern Student

2.3.1 Changes and Expectations

- the modern 18-yr old on entry to university is quite different from his/her counterpart of some 15-20 years ago
- while syllabi and courses have evolved, many university teaching policies and practices have remained largely unchanged over the same period
- university teaching and learning processes need to recognise the changes in the student, and react to these changes, to improve learning in the university
- students on entry are not aware that teachers' expectations of their learning attitudes and skills can be, and often are, quite different
- often the mismatch between learning skills and academic staff expectations of them is evaluated only in terms of academic ability (or lack of it).

2.3.2 The Student on Entry

It is clear that

- students are often not aware of their own learning skills (or lack of them)
- lack of understanding of learning skills as a concept leads to under-development of learning skills as an active pursuit
- students can have skills relevant and important for learning that somehow do not show up in the academic context

- learning skills are often only assessed (explicitly or merely through superficial judgement) in an academic context, and hence other factors may thus be ignored.

Clearly, different students possess different levels of different skills – it is impossible to make categorical statements.

2.3.3 Enabling Skills on Entry

There are several basic skills which it is assumed, often incorrectly, that students possess on entry. At university level they are necessary to facilitate students' learning. These include reading (skim, scan, read-in-depth), information retrieval (from books, journals, CD-ROM, internet), writing (notes, reports, information digests or summaries) oral (explanations, presentations to different audiences, participation in and benefiting from group discussions) computer literacy (word-processing, spread sheets, data-base manipulation, internet, production of visual aids).

Clearly all of these skills will be enhanced and extended during a civil engineering course but it is essential to evaluate students' proficiency on entry and provide learning opportunities whereby these skills can be developed to a level adequate for their use within degree/diploma courses.

2.4 Evaluating Student Attitudes – an Exploratory Investigation

2.4.1 Context

As mentioned previously, students enter university after following various routes of preparatory education that, by their nature, encourage particular attitudes towards learning and towards the wider world. These attitudes are a complex combination of personality and education, in the broadest sense of that word. It is therefore extremely difficult to measure or quantify those attitudes, but it is by no means certain that they are best suited to those needed in an engineering profession.

Equally, it is not possible to define a set of learning skills and attitudes which are optimum for any profession, simply because there is no optimum set and the balance of any set will most probably need to change during a lifetime's career. This is especially so given the mobility essential to working in a modern professional society subject to and motivating change at an ever increasing rate.

Of the various schemes which attempt to quantify learning attitudes, that developed by Honey and Mumford (1995) over a period of some fifteen years was used in this exploration of student attitudes. The scheme has been used extensively in various professions, most commonly with younger employees.

It is not ideally suited to university students but, given the available time-scale of the working Group's activities, it was considered appropriate for the present, exploratory purposes. The scheme was also advantageous because it could be applied, with care, by colleagues, who were not au fait with the finer aspects of attitude evaluation, but who were highly experienced in university engineering education.

2.4.2 The Evaluation Scheme

The scheme is based on a questionnaire developed by Honey and Mumford (1995), http://peterhoney.com which is intended to provide a vehicle with which learning styles and their relative strengths can be assessed. The questionnaire, consisting of eighty questions, relates to general attitudes because most students have not thought objectively about their learning styles so a questionnaire on learning style as such would not be particularly informative! However, there is strong evidence that attitudes in general relate directly to preferred, and therefore optimum, learning styles.

2.4.3 Learning Styles

In the Honey and Mumford model, styles are divided into four separate categories that can, to a reasonable degree, be paralleled by actions:

CATEGORY	ACTION
Activist	Experience
Reflector	Reviewing the Experience
Theorist	Formalising the Experience
Pragmatist	Planning responses

The "action" sequence is, to some degree, a parallel to professional activities in a design context.

In brief, the characteristics of the different categories, which will be reflected in preferred styles of learning are:

Activist:*
Lives in the here and now, go for it and try anything once. Tends to act first and think later, enjoys "brainstorming", is gregarious and becomes bored by the longer term.

Reflector:
Likes to stand back and think about it, using collected data and information, tends to be cautious and thoughtful, listens to and observes others, keeps a relatively low profile and is tolerant.

Theorist:
Enjoys integrating observations into theories, likes analysis and synthesis, tends to be a perfectionist and think in a logical, sequential mode to maximise certainty.

* This term, when translated into the French ACTIVISTE may be inappropriate. It is retained here in view of its widespread use in the evaluation of learning styles.

Pragmatist:

Likes to try out ideas and theories to see if they work, gets on with things and is impatient with reflecting, essentially a practical problem solver, feeling that there is always a better way and if it works it is good.

It is important to emphasise that **THERE IS NO OPTIMUM BALANCE OF LEARNING STYLES OR ATTITUDES FOR AN INDIVIDUAL, SOCIALLY OR PROFESSIONALLY**, although in forming teams for specific projects the profession looks for a balance of attitudes and skills. Similar considerations apply to the formation of committees and significantly influence their effectiveness.

2.4.4 Completion of the Questionnaire and Results

The questionnaire consists of eighty short questions to which a "yes" or "no" answer is required and was completed by students from a range of universities, as indicated in the table of result below. The students were informed that the exercise was run solely to allow them to explore their own learning styles and to allow them to consider how they might improve their learning modes.

The table 1 and its accompanying figure 1 summarise the results, for which the standard deviation of the scores must be noted with care!

It is clear that care must be taken in deriving conclusions from this data. However, in all institutions the "Activist" component in student attitudes is a minimum. Reflector is generally high with Theorist and Pragmatist at slightly lower levels. It is also noted that translation of the questionnaire into French, German and Portuguese, which was undertaken by members of the Working Group, may have induced bias into the responses.

There are differences between students in the early years of their course and those in later years but rather marginal. From our personal experience it is clear that students' attitudes evolve during their course. It is also clear that attitudes, as tested in this **exploratory exercise**, appear to change only marginally during the students' university careers. It is likely that the present format and content of the questionnaire is not sufficiently sensitive to detect such changes, noting that the questionnaire was not designed specifically for student use.

The general pattern of results given in the Table 1 might be expected in a university environment that follows dominantly theoretical and reflective work in schools immediately prior to university entrance. The pattern will also be conditioned by the selection process used for entrance to engineering courses. Therefore the potential benefit to colleagues is likely to be derived from a sequence of applications of this, or more students-focussed evaluation systems, in their own institutions.

Students were invited to comment on the benefit that they felt they might have obtained from this exercise – which took only one hour. Almost without exception the comments were positive, very few students had previous experience of "looking at themselves" in this way. There was a cautionary comment; several students said that they were not sure that their responses to the questions reflected themselves as they are or as they wished to be.

This potential anomaly is a matter for them to resolve as individuals.

In terms of individual reactions, the students were informed that the accuracy of self-perceptions is usually confirmed by people who know them, although they may act differently to different people and thus bias external perceptions.

It was suggested that they might check their results by reviewing the answers to each question, re-examining those that they felt were marginal and collect feedback from their colleagues' observations of them.

2.4.5 Implications in a University Context

Honey and Mumford (1998) present contexts or conditions that are favourable to a given learning style and those that are unfavourable. The following is an abbreviated version of their listing:

	Favourable	*Unfavourable*
Activist	new experiences/opportunities	passive roles – lectures
	short, "here and now" activities	analysis of lots of data
	a leading role	solitary work
	generating new ideas	theoretical details
	"thrown in at the deep end"	precise instructions
	involved in a team	tasks needing much detail
Reflectors	time to think before acting	forced to the front
	reviewing activities	actions before planning
	producing carefully analysed reports	insufficient data
	structured learning processes	short time limits
	no tight deadlines	no advanced notice
Theorists	work on models, concepts, theories	no obvious purpose
	chance to query methods	emotional situations
	intellectual stretching	lack of policy
	focus on logic and rationality	unsound methods
	analysis and generalisation	subject of limited depth
Pragmatists	links between problems and solutions	no immediate need
	techniques for solutions	distant from reality
	feedback from experts	no clear guidelines
	experts to emulate	lack of actions
	practical issues	insufficient rewards

The results obtained in this **preliminary exploration** of attitude testing are of interest in the sense that they, hopefully, encourage colleagues to review their courses to determine if the delivery and style (lectures, tutorials, seminars, group work etc….) of those courses provide opportunity for students to improve one or other measure of their personal attitudes. It is important to note, as is discussed elsewhere in this report, that general attitudes reflect the optimum learning styles or modes of students.

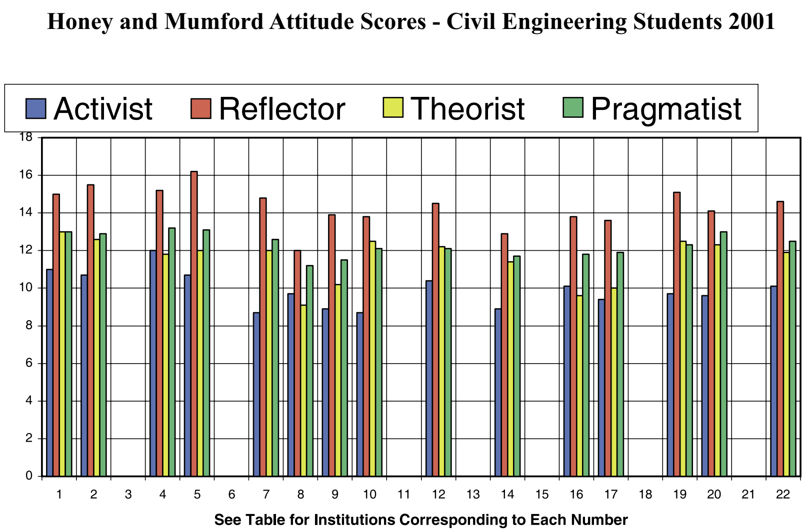


Figure 1

School	Number on Attitude Scores Graph	Year/Sem	Sample Size	ACTIVIST		REFLECTOR		THEORIST		PRAGMATIST	
				Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std.Dev
University of Coimbra	1	1st Yr	57	11	2.62	15	3.2	13	2.79	13	1.89
	2	3rd Yr	49	10.7	2.68	15.5	3.06	12.6	2.93	12.9	2.85
Universit of Beira Interior	4	1st Yr	38	12	2.7	15.2	2.58	11.8	3.26	13.2	2.07
	5	3rd Yr	40	10.7	3.01	16.2	2.3	12	2.56	13.1	2.29
Norwegian University of Science and Technology	7	1st Sem	18	8.7	3.1	14.8	2.71	12	2.46	12.6	2.64
	8	2nd Sem	11	9.7	3.2	12	4.45	9.1	3.73	11.2	3.84
	9	4th Sem	18	8.9	2.71	13.9	3.42	10.2	3.25	11.5	2.11
	10	8th Sem	23	8.7	3.2	13.8	3	12.5	2.96	12.1	2.54
University of Cardiff	12		43	10.4	3.34	14.5	3.57	12.2	3.49	12.1	3.16
Odense Teknikum	14		43	8.9	3.85	12.9	3.74	11.4	2.55	11.7	2.92
Techniche Universitat Dresden	16	1st Yr	32	10.1	2.96	13.8	2.55	9.6	3.17	11.8	3.07
	17	3rd Yr	27	9.4	3.41	13.6	3.12	10	2.51	11.9	3.39
Imperial College	19	1st Yr	70	9.7	4	15.1	3.6	12.5	3.2	12.3	3.3
	20	3rd Yr	65	9.6	4.2	14.1	4.1	12.3	2.8	13	3.2
All Data	22		399	10.1		14.6		11.9		12.5	

Table 1. Results of the Application of the Honey and Mumford Questionnaire

2.4.6 Changing Attitudes

Honey and Mumford provide indications of the actions that individuals might take to improve weaker styles – should they wish to do so. Those indications are summarised below because they also contain indicators of how the engineering academic community might consider providing opportunity for students to do this within the context of their studies. Compensating for a weakness is not easy because it is probably contrary to an individual's natural inclinations, against stronger styles and attitudes. A university is the ideal place in which students can experiment with actions they have not experienced before; involvement with different societies, sports, arts etc. can all help in improving both stronger and weaker learning styles. But it is considered that there should be equal, if not more, opportunity within the academic disciplines studied.

To increase an **ACTIVIST** style:
Do something totally new
Try initiating conversation
Change your activity to something contrasting every half-hour
Force yourself into the limelight
Practise thinking aloud on your feet

To increase a **REFLECTOR** style:
Practise observing people - verbal and non-verbal behaviour
Keep a diary and reflect on the day - with conclusions
Review an event, meeting or lecture - identify key elements
Do some research on a new topic - use the library
Try to produce a polished piece of writing
Draw up lists for and against a specific course of action

To increase a **THEORIST** style:
Read something "heavy" for 30 minutes a day
Analyse a complex situation - why did it go the way it did?
Spot inconsistencies in other people's arguments
Collect contrasting views on one topic and find the key themes
Try to structure your day/work
Ask probing questions

To increase a **PRAGMATIST** style:
Collect or design techniques, procedures for doing things
Experiment with your new techniques
Produce action plans with targets and dates
Study techniques people use, evaluate them - e.g. in lecturing
Subject yourself to scrutiny from "experts" - coaching sessions
Tackle a "do it yourself" project

A comparison between the provision of different learning style opportunities and the learning style preferences of their students is clearly a matter for individual faculties, departments and academics.

There is a general consensus that a balance of styles and attitudes between the four categories explored in the present study is probably best for the majority of students in higher engineering education, but there will clearly be exceptions. If this general statement is valid then there is a need to provide more open-ended learning experiences that encourage the development of a more pro-active attitude in students. The engineering profession often seeks those who "can make things happen" and have the confidence to do so.

2.4.7 Towards Life-long Learning

It is clear to the Working Party that the exploratory exercise has generated various topics worthy of further consideration in the context of higher engineering education. Learning styles and preferences developed in university form the basis of continued learning in the profession. Therefore, if the dominance of reflector/ theorist learning styles continues beyond the degree/diploma level, the provision of life-long learning opportunities will be optimised by recognising this.
However, it may well be that in the later years of an engineering education, students' attitudes become more active as they prepare to enter the profession. In that case, providing life-long learning experiences in the traditional "text plus illustrative material" format may be less effective. It is notable that in some professions, notably finance and banking, in addition to traditional modes of continued learning there seems to be a growing emphasis on learning by activity, supported by peer analysis and discussion of performance. These tend towards the active/pragmatic sectors of the learning styles domain.

2.5. Summary of the Exploratory Exercise

The exploratory study of student attitudes and learning styles has confirmed expectations that reflector styles are stronger than theorist/active/pragmatic, based on a limited sample of students and using a particular vehicle for the evaluation, namely, the Honey and Mumford questionnaire. It is recognised that the particular questionnaire used was not ideally suited to university students but it was considered adequate for this preliminary exploration of the topic. Tests designed more specifically for student use may well be preferable, for example, the Belbin Test, (http://www.belbin.com).

Preliminary views of the modes of learning provided in higher engineering education indicate, again in general terms, that relatively less opportunity is given for students to develop active/pragmatic attitudes should they so wish. However, it is noted that needs and provision will vary considerably between institutions. Problem Based Learning is clearly an excellent example of providing opportunity for students to develop these latter styles and to gain confidence on so doing.

The present survey provides only limited indications of how student attitudes and learning styles might change in the later years of their courses, although there is a general feeling that active and pragmatic attitudes increase. This has important implications in the provision of life-long learning opportunities but it must, of course, be shown to be true by further surveys.

The Working Group considers that there is insufficient recognition of the differing learning preferences of students entering higher engineering education and there is clear potential for further work in this area. This will require a refinement of the questionnaire or the development of an alternative more penetrating means of evaluating those styles and, importantly, a more detailed investigation of the learning modes which different educational activities provide.

It must be emphasised that there is no unique optimum balance of attitudes but the purpose of a university education is to provide opportunity for students, with the support of academic staff, to develop their own styles and attitudes in a way which they consider to be the best.

2.6 General characteristics of Modern Students

Characteristics that are *generally* true in the modern student can be itemised, as below:

2.6.1 General Characteristics:

Visual stimulus – the modern student is often more reactive to visual stimulus than the traditional student, to the point that the lack of visual stimulus can have a negative impact. On the other hand, even a simple and irrelevant visual stimulus (e.g. some background colour/image) can enhance interest and motivate. Examples of visual stimuli include use of colour, use of background images/photographs, simple computer animation (e.g. flashing words, appearing/disappearing text) and complicated computer animation (e.g. simulation, 3D walkthrough).

Multi-media – students are very accustomed to multi-media forms of presentation (e.g. through news and commentary presentations on television & internet advertising), and hence becomes intrinsically less stimulated by single-media static presentation.

Hand-eye coordination – the modern student typically has good hand-eye coordination which is useful in practical exercises such as technical drawing, use of electronic equipment (especially pointing devices), and adjusting laboratory instruments.

Dexterity – similarly, modern students usually enter with high motor-neurone skills.

IT/Gadget – students usually have considerable personal experience with modern electronic gadgets (e.g. mobile telephones) and tend to expect similar levels of use of such equipment and facilities in universities (e.g. laptops used in lectures, lecture notes downloaded from intranet, email/text messaging as standard communication tools).

PC – students usually have very good computer skills and possesses intrinsic understanding of MS-Windows based software architecture. Students often require minimal help in starting/using new software packages, and are not intimidated by new packages. At the same time, the student might associate what has been produced by a computer to be accurate or correct (e.g. analytical output from a design program, graph from a spreadsheet program).

Tasking level – the student is better able to handle (particular to focus their attention on) several small sequential/inter-dependent tasks than one large (equivalent) task. The student is also less able to decompose a large task into smaller more manageable components themselves.

Incentives – the student responds better to tasks which are reward-based and particularly to rewards that are immediate and clearly defined, as opposed to some high-level long term aims such as "better job prospects." The reason for doing something, and the benefit that can be derived from a task, become important motivators in doing it. The lack of clear and immediate reward then discourages investment of large amount of time into the activity (however important) and eventually the work becomes deadline driven. It is done because it has become urgent, rather than because it is important.

Single-path problem – students have a tendency to expect problems to be clearly defined, deterministic and single-pathed (i.e. only one clear solution to each problem). They are less able to deal with concepts of uncertainties/ probabilities existing in solutions.

Repetition – there is a tendency for low tolerance of repetitive tasks unless a high stimulus is provided alongside the repetition. Together with the idea that problem solving is single-pathed, the student might have fundamental difficulties with an iterative approach to problem solving.

Practically based – the student is more responsive to practically based tasks rather than philosophical concepts and are hence more prone to ask "what do I do" or "how do I do it" rather than "why do we do it this way." Since developing a theoretical/philosophical base (i.e. working from whole-to-part approach) that eventually shapes thinking is time and effort consuming and contains no quick reward, the student is likely deliberately to opt for practical tasks which do have immediate and clear outcomes.

Synthesis/classification – the student's better ability to work and focus on smaller tasks is often accompanied by difficulties with synthesis (assembling a whole from the parts) and classification (identifying and then categorising defining features). There may also be a difficulty with looking for and identifying commonalities across artificial boundaries (e.g. applying analogies across different subject areas). This can be exacerbated with the modern modular approach where subjects are sectioned and presented as separate elements. There is a danger that knowledge and understanding become fragmented and compartmentalised in the mind of the student, leading to an underlying difficulty of applying principles from separate sources to one problem.

Extrapolation – there is often a reluctance in the academic context to move from the edge of what is familiar to what is new. A problem based approach to learning does not necessary help students to build up the concept base upon which the student can rely as he/she extrapolates. The student is probably more at ease with interpolation in which he/she builds up a problem-bank by learning how to solve a series of problems and then tries to solve a new problem by comparing it to one already in the problem bank.

Perseverance – the student's perseverance in a problem is likely to be conditional, and dependent on level of a number of stimuli including:
the availability and speed of responsive guidance;
the presence and amount of peer-pressure; and
confidence of some reward soon.

Scale of importance – there is a possibility that with an emphasis on compartmentalisation and "bite-size learning," the student has a diminished scale of importance, so that what is really important is less distinguishable from what is not. In such a case, everything is treated as important or unimportant. A typical consequence of this might be seen in an inability to distinguish the significant contributors from the trivial in experimentation.

Enjoyment – it is possible that that the modern student places greater value on "enjoyment" as a motivational effect and, as a consequence, what is enjoyable (however trivial) is pursued with greater enthusiasm than what is actually important. This could be worsened by a diminished ability to distinguish importance.

2.6.2 The Next Steps

Recognition of what the student is like on entry is not an end in itself, it merely helps the teacher and student to know how to direct teaching and learning. There are still important issues like:

- how learning skills can be measured, both in the academic context and outside it;
- how learning skills apparent in non-academic contexts can be activated and encouraged to develop in academic context;
- how deficiency in any one skill can be identified;
- how learning skills can be systematically developed in a student;
- how new skills not native to the student on entry can be introduced and developed during the course of study;
- how students can become aware, self-assessors, and self-reflectors of learning skills.

The table 2 **Skill acquisition (and how) at University**, illustrates the educational processes, e.g., lectures, tutorials, seminares etc. that provide opportunity to enhance specific skills in Academic, Personal, Group Working and Communication Skills.

In the opinion of the Working Party this table should form the basis of all re-designs or extensions of civil engineering courses, adapted, of course, to suit the stated objectives of particular departments or divisions within a university.

2.7 Summary

Student attitudes on entry to a university course have changed markedly over the years but there has been, in general, much less change in the attitudes of academic staff and the modes in which students are given the opportunity to educate themselves. There is a clear case for application of an attitude test more specifically designed for use at student level, for the benefit of both students and academic staff.

It is essential that these changes are recognised and **that courses and the ways in which they are delivered** are re-designed to improve the learning process, based on the table of skills acquisition given below.

The key element in civil engineering education is the set of skills that students acquire during their university courses. Giving students improved opportunities to acquire these skills, and demonstrating that they have acquired them, is essential.

Table 2. Skill acquisition (and how) during university
5=New skill entirely acquired through university, 1=old skill acquired entirely in school, no improvement in university

Academic Skills	Personal skills	Group working skills	Communication skills
Information research = 4+ Extensive internet provision, extensive library provision (bigger, better), exercised through project requiring library research use	**Review and reflection in learning = 4** Dominant in design work and final project	**Teamwork = 4** Formally through team design exercises, and informally in studying together, but also in student societies.	**Writing = 2** Writing skills are generally well formulated before university but students do learn to write technical reports and notetaking.
Synthesis = 4+ Design exercises, laboratory reports, final project	**Self assessment = 5** Through comparison with others in formal and informal group working, also encouraged in discussions with personal tutors	**Understanding/Tolerance of others = 3** Through general university life, and usually in a diverse international community.	**Audio/visual presentations = 3** Found in group presentations (usually in design exercises), but also sometimes in viva voces. Not a universal feature though.
Critical thinking = 4+ Design exercises, laboratory reports, final project	**Planning and decision making = 5** Found in project and design exercises, especially designs involving groups of students	**Negotiation skills = 4** Through general university life, but also in group work in general, and project management design work in particular.	**Active listening = 2** A skill usually developed before university, but students are exposed to longer and more intense presentations.
Active/independent learning = 5 Design exercises, laboratory reports, final project, electronic learning (intranet, distance learning)	**Time management and self-discipline** = 3+ Exercised throughout the course but particularly in coursework with hand-in deadlines.	**Peer assessment = 5** Informally in general group work where students have to be critical of one another's work, and formally usually in assessing presentation and conceptual designs	**Foreign language/s = 2** Not usually a core development, but is central in schemes with exchange programmes.
Problem solving = 4+ Throughout tutorials, exercises etc, but principally developed in design exercises and final project	**Independent working in new context = 5** Project and design exercises, especially designs involving groups of students	**Leadership = 3** Found in group work, group design, student committees, student societies and sporting activities.	**Numeracy = 5** Developed extensively in pure and applied form throughout the course.
Project management = 5 Taught as a module, including exercises	**Taking initiative and be proactive = 5** Experienced through student committees, student societies and student/staff committees.	**Being adaptability/manage change = 4+** Adaptability to change is a frequent feature in design exercises so students have to be concerned with evolving/iterative parameters	**Information skills = 4** Developed mainly in design exercises, laboratory reports, and final project.
Creativity/Innovation = 4+ Design exercises exploring different solutions, drawing, architectural concepts/designs,	**Budgeting = 5** Some commercial aspects are taught, but budgeting issues are encountered as part of real-life experiences in university		**Computer skills = 3** Modern students usually already have well developed computer skills, but are exposed to more advanced and technical software.

3. New teaching methods and processes

3.1 Types of Learning Opportunity

It was not the main purpose of the Working Group to review teaching methods or modes but, given the importance of relevance and effectiveness of civil engineering education, it is helpful to identify different types of learning opportunity that are made available to students at the undergraduate level. The categorisations used are by no mean rigorous but are sufficient for present needs; they are:

1. Lectures
2. Tutorials
3. Seminars
4. Design Classes
5. Physical Model Studies (Laboratory Experiments and Practical Demonstrations)
6. Numerical Model Studies
7. Projects – Design
8. Projects – Research

3.2 A Brief Review of Types

3.2.1 Lectures

The style and mode of lecturing to undergraduate students varies, rightly, between different members of academic staff and between different institutions. The major variable is the way (or mode) in which information is presented:

(a) **Talk and Chalk** – without the provision of lecture notes, in an expectation that student will copy from the black/whiteboard. This mode has been largely discredited but is used to some limited extent.

(b) **Notes and Visual Material** – this mode is seen to be effective provided that, as progress is made through the core material of the course, additional contextual information is also discussed, e.g. the potential deficiencies of a theoretical model or the practical context of its application. It is noted, importantly, that the latter constitutes a part of students' education in "design".

(c) **Computer-Based and Projected Notes –** this "new" mode is refinement of the overhead presentation mode with advantages of colour, animation and sequential presentation of information on individual slides, especially beneficial to students who are visual learners. Development of such modes takes very considerable effort but has the advantages of easy modification to improve understanding, up-dating etc. However, experience shows that providing students with a hard copy of a series of projection images, MS Power Point for example, is not effective unless those images and content have been specifically designed to "stand alone".

3.2.2 Tutorials

Tutorials are defined as times at which the learning process is less formal than a lecture and students are able to interact on a one-to-one basis with members of the academic staff and/or postgraduate teaching assistants. Generally, the purpose is to enhance understanding of concepts by their application to specific cases. In practise the student/staff ratio in tutorials varies but a ratio greater than ten is considered to become ineffective in a tutorial mode. Tutorials can be divided into sub-types:

"Traditional" tutorials in which tutorial groups are tutored by an individual member of staff and/or postgraduate teaching assistant and covering one subject area;

Group tutorials in which a limited number of students – four to eight – work with a "Graduate Teaching Assistant" (GTA) who may provide support in more than one subject area. The concept is said to be one of "enabling" rather than direct tutoring but has serious limitations unless the tutors are properly trained.

Student to Student tutorials, in which students in later years of the course interact with those in earlier years. Many Departments have developed this mode recently, often on the initiative of the students themselves, but without any training of the tutors. The practise is therefore unlikely to be optimal in an educational sense; it may, in crude terms, emphasise "how to do it" rather than "why and how to do it"

3.2.3 Seminars

Seminars, at the undergraduate level, are seen to be educational experiences that include a combination of new information/concepts and their application. This activity is similar to **Group Work** with support for the group from academic (and GTA) staff. This mode of delivery is of increasing importance from a professional point of view. It does present problems in evaluating student performance but the link between this mode and the development of important, identifiable skills by the students is a clear advantage.

Obviously such developments have resource implications and the specific benefits of the seminar mode need to be identified in educational terms. It is noted here that **Group Work** by a number of students selected almost randomly does not equate to **Team Work.** In the latter, the membership is chosen on the basis of specific complementary attributes of each member. For team selection – noting that Team Work is a key activity within the profession – it is necessary to evaluate the attributes of students in an appropriate way and to base team selection on a balance of those attributes within each Team (see below). This has become standard procedure in some Departments of Civil Engineering.

3.2.4 Design Classes

It is difficult to define "design classes" but, essentially, the objective relates to synthesis as opposed to analysis, with students being given the opportunity to create, to think broadly, to exercise initiative and become pro-active, often working within a group/team. The attitudes that these processes develop are in contrast to the general student attitudes on entry which are more strongly analytical and reflective.

It is clear that design classes and the final year (research) project, see below, make up almost the total of student experience in self motivated innovation. Given that the profession seeks graduates who will be at the forefront of professional activities in taking new initiatives, it is essential that undergraduate courses are reviewed with particular priority being given to the provision of opportunity for students to experience this type of creative activity.

3.2.5 Physical Model Studies - Laboratory Classes

There are severe pressures on laboratory work – cost, technical support, academic staff time, space etc. - which may have resulted or may result in a serious, detrimental reduction in the amount of such work undertaken by students. Given these restrictions there may well be a case for developing virtual laboratories in a Computer Aided Distance Learning (CADL) context. However, the value of "hands-on" experience coupled with that of analysing data which is not necessarily accurate, comparing with theory, drawing conclusions and reporting on the work cannot be equalled in any other way and are essential to the proper education of potential civil engineers.

3.2.6 Numerical Model Studies

The use of numerical models in support of learning in a range of topics, from physical processes to design, is a growing practise in civil engineering education.

Owing to the rapid development of computer hardware that is matched by a steady fall in prices, numerical modelling is assuming an increasingly prominent position in engineering and the sciences. This trend is likely to persist in the foreseeable future; we are currently at the point where computing power on the desktop rivals that of mainframes of twenty years ago, and in ten years the average desktop machine will be as powerful as a Cray machine of the mid-nineties.

However, in all this there exists a fundamental problem that does not have to do with numerical modelling per se, but how to handle huge amounts of information that result from it so as to extract meaningful *knowledge*. More available computing power for undertaking a simulation implies large volumes of results that require *a lot of time* for inspection. Therefore the emphasis currently is on the development of tools that facilitate inspection of numerical results and the associated decision making process. Such tools are *very slowly* finding their way into teaching.

These tools range in complexity from the almost straightforward to those that still have unresolved problems of implementation, with a large gray area in between. The first category includes packages like Mathematica, Mathcad, Matlab, Avs, ProEngineer, and the like. There are learning curves of different steepness associated with each one of these packages, but essentially they all do the same thing. What is important are the underlying visualisation protocols used. In this context the choice is between the OpenGL standard and the VR (Virtual Reality) framework for the visualisation of 3-D data. The development of these is in the final stages although VR, by virtue of being the less popular one, requires more work. Packages like those mentioned are already used in teaching. One should also include in this category data visualisation techniques that, although they are not quite mainstream, are currently reasonably well established. These include virtual reality, for a "walk through" kind of visualisation, as well as the use of holographic images.

The fundamental flaw of the above tools is that they are *not* Web-based; this makes sharing and exchange of data and information from numerical simulations difficult. The Web is the make-or-break arena for realising a meaningful and practical information exchange. The Java programming language has done much to promote interchange of code, but at the display of information end things are not so clear. At the moment the HTML protocol, owing to its primitive structure, cannot address the issue. However, the emergence of XML as the Web language of choice promises to do for information what the Java language has done for programming code. The state of XML development is still rather fluid, but standards have emerged as well as applications that support it (Java from IBM alphaWorks, MathType etc.). XML promises a lot because it can be used to describe content and not just presentation like HTML, and in this context it should become the language of search engines. At the time of writing the writer is not aware of teaching packages that use XML. Clearly, the rate of change in numerical modelling and in the effective communication/interpretation of results is extremely high. The profession is adopting new computer-based procedures based on the pressures of the marketplace at a pace that universities will have difficulty in matching."[5]

3.2.7 Design Projects

An important element in Design Projects, which include Problem Based Learning, is the integration of a number of sub-disciplines into one activity, thereby reducing the degree of compartmentalised thinking by students, encouraging a more holistic approach, and experience in *team* work – noting that "group" work and "team" work are different in that the latter involves specific selection of a team with members having complementary skills and attitudes.

Given that the skills involved in this are very important components of a "skills set", it is clear that this and other cross-discipline activity should be expanded within undergraduate courses.

3.2.8 Research Projects

A "research" project provides an important opportunity for a student to explore a topic in considerable depth, guided, of course, by a member of the academic staff. It is the epitome of self-motivated learning and requires a combination of a number of key skills. By definition, research activity implies originality in the work, and involves creative thinking, information retrieval, the design of a programme of work, laboratory or numerical experiments, communication and other skills. It is difficult to provide opportunity for students to develop some of these key skills in any other context.

3.2.9 Computer Aided Distance Learning

Here we differentiate between computer-supported lectures etc. and CADL. The essential difference is that the latter can be undertaken "off-line" at a time of the student's choosing. The topic is extensive, with rapid developments in a number of different directions and merits a section of its own, in Section 4, below.

3.3 Summary

The list of different learning opportunities given above is by no means complete and may well have different titles in different institutions. However, the main evolution in university learning is a more direct objectivity towards learning objectives and skills acquired. In some departments students maintain a log-book listing skills acquired from each course taken – the academic staff responsible for those courses having previously defined the learning and skills objectives. This is a commendable practise and allows beneficial "feed-back" from the students to the academic staff.

Generally there is a trend away from "mass" conditions, e.g., lectures to large numbers of students, to more informal, smaller group activities with much more interaction between the student and the academic. This obviously has serious resource implications but if there is a genuine wish to improve civil engineering education, those resources are essential.

4. Computer Aided Distance Learning

4.1 Outline History

Civil engineers were amongst the early users of the digital computers. They were used for logging data, for doing long and/or difficult calculations, for technical drawings and for controlling machines. These experiences led to the development of finite element packages and the CAD and CAM systems that are now widely available.

Although these developments were not specifically intended for teaching and learning purposes, it was obvious that many of these programs could be used for those purposes. Take the finite element method as an example. It is obvious that structural engineering students at universities should be at least aware of the method of analysis. It may even be argued that the university student should understand the principles and technical details of the method. The university teacher is able to teach finite element theory without too many difficulties using traditional teaching methods. However, many would argue that when structural engineering graduates leave the university to work in design offices should be familiar with "using" a finite element package. In fact, because the calculations involved in solving a finite element problem by hand can be tedious, many would argue that the ability to use a finite element package is necessary when the student is in university to assist understanding of the finite element method or principles. Thus it is reasonably common for university engineering departments to provide access for students at both undergraduate and post-graduate levels so that they are able to use finite element packages. Nowadays, many university academic staff and students used computers and "professional" engineering programs for teaching and learning purposes.

However, such programs are not fundamentally designed for teaching and learning purposes. They are designed either to solve research problems or for use by engineers in a professional capacity. Nevertheless using such programs served a teaching and learning need to some degree.

4.2 Information Systems

In several European countries the need to promote innovative applications and use of information systems and information technology in a university context was recognised with the formation of Information Systems – The Joint Information Systems Committee in the UK (www.jisc.ac.uk) and the German Bildungsserver (www.bildungsserver.de) are good examples of this.

The development of efficient teaching and learning tools progressed slowly until the early 1990s, when IT tools such as Authorware, Tool Book etc., became available. These tools, which were relatively easy to use by non-programmers, allowed for the rapid development and delivery of computer based teaching materials. The availability of such tools allowed national educational funding councils, universities and industry to support the development of teaching materials in a number of European countries. Examples of these programmes include: TLTP (Teaching and Learning Technology Programme) and the FDTL (Fund for the Development of Teaching and Learning) www.ncteam.ac.uk in the UK, AHD (Association for Research and Development in Higher Education) www.ahd-hochschuldidaktik.de and HIS (Higher Education Information System) www.his.de in Germany, the Austrian Association for Didactics in Higher Education ÖGHD www.oeghd.or.at and, in Switzerland, the Centre of Teaching and Learning DIZ at the ETH Zurich www.diz.ethz.ch.

One of the main projects under TLTP was the COMPACT (Computer aided teaching in concrete technology) project. This project produced a suite of computer-aided learning programs covering 11 topics on concrete technology and the design of concrete structures to the EC2 codes, where appropriate. Designed primarily for undergraduate use, the interactive programs use high quality photographs and graphics to present teaching material in an easily absorbed and interesting manner. Several of the modules, particularly on reinforced concrete design, will also appeal to graduate engineers wishing to familiarise themselves with EC2 codes. UK universities used the Authorware based COMPACT suite in a number of ways and the modules and some of the evaluation history are available from www.compact.org.uk.

Another example of an electronic text book, which combines new design codes (EC2), explanations, examples and design tools, is the BK3 – the electronic Betonkalender (see www.progeo-software.de). Interaction and browsing functions ensure an active learning process. The tool book can be published via CD-ROM or largely made available via the internet and can be used either for undergraduates or for graduate engineers. The extensive requirements for such a CD-ROM system are given in Example 1, below.

Example 2, below, provides an excellent illustration of the context in which computer aided learning must be developed in order to provide a coherent ”package” that students can readily adapt to and integrate into their studies.

Although systems such as Authorware (www.macromedia.com) enabled the development of computer based teaching materials, the end product is essentially an “electronic” textbook with “interactions”. The teaching content of subject matter had to be integrated into the system. This is a major drawback when an academic wishes to modify the content for a different learning objective. Ideally, the academic content should be separate from the system to enable re-use of the academic material. Because the system is a commercial product, the other major issue related to the use of such systems is that the academic is tied into the pedagogic model of the system. This is perfectly acceptable if the academic wishes to be so restricted but most academics use a range of teaching approaches in their courses in response to the needs of their students. Therefore, being tied into a system is not necessarily a good thing.

With the arrival of the world wide web, academics started using the web for delivering teaching materials. Initially only text based teaching materials could be used but with the development of the web for the delivery of multimedia products (videos, animations and sounds), it is widely viewed as an appropriate system for the delivery of teaching materials. Combining the browser functions of the web with other communication features such as email systems can result in a powerful electronic based teaching system. Electronic text book systems such as Authorware have responded to the web based developments and have made their systems deliverable over the web. Most of these systems, such as WebCT, are also commercially based and also suffer from the basic restrictions, described above, which are inherent to such systems.

4.3 Sources of Information

The internet also offers new ways of publishing content. An example of such a hypermedia tool, based on digital slides to learn from post-earthquake investigation is the EASY information system (www.ikpir.fgg.uni-lj.si/EASY). Systems like these offer navigation and search options and can be made available via the internet and on a CD-ROM. This system is illustrated on Example 3 , below.

Nevertheless, the complexity of internet publishing and/or multimedia/ interactive programming often remains a technical burden for the teacher/ academic. There are systems to support the academic who wants to publish on the internet. A good example is the user-friendly, web oriented database system called WODA (www.fgg.uni-lj.si/~zturk/works/wb) which is used in the University of Ljubljana, Slovenia. WODA allows the rapid creation of database applications that could be used and managed using Web tools.

A major issue of the use of IT in teaching and learning relates to the effect on people with disabilities who have additional demands on the system – see www.techdis.ac.uk. It can be argued the needs of disabled students should not be looked upon as additional requirements for the development and use of IT systems but that designing for disabled students benefits all users.

Nevertheless, the other major limitation of most of the current systems is that they adopt the “one size fits all” attitude. All users have to follow the same paths and cover the same teaching materials. Such systems are not “adaptive” to the needs and the backgrounds of the users. Nor do such systems take the users style of using the web or the teaching system into account. Development of “adaptive” teaching and learning virtual learning environments (VLE) is now taking place – see whurle.sourceforge.net. One of the other main features of WHURLE is that it is intended as an open source system.

The other open source VLE that has come from developments at the University of Leeds in the UK is available via www.bodington.org. The main advantage of open source systems is that they attract a large worldwide pool of contributors to the development and checking of the system under development. By default this way of development stands a better chance of the system reflecting the needs of the users. All members of EUCEET and academic colleagues elsewhere are encouraged to participate in such projects.

Beyond the use of IT for “upgrading” or “replacing” “traditional teaching methods” there are attempts to use IT methods for group based or project based learning methods – see www.pble.ac.uk and pbl.stanford.edu. It is recognised that the words upgrading, replacing, traditional teaching methods and project based learning have different meanings to different people and the various interpretations are not discussed here.

In addition to the technical and educational issues related to the use of IT for teaching and learning purposes, the university academic should be aware of the related commercial issues. Many universities are seeking to commercialise their expertise by organising "open/distance" learning courses, using commercial or in-house VLEs. The Massachusetts Institute of Technology has taken a radically opposite approach which is to be applauded, namely to oppose the commercialisation of knowledge by making "the materials from virtually all of its courses freely available on the World Wide Web for non-commercial use" - see web.mit.edu/ocw/ . Some other universities (i.e. University of Notre Dame - www.nd.edu/~linbeck/) are also offering free lectures on the internet.

It would be good if the open source approach to using IT for teaching and learning purposes and the MIT approach turn out to be dominant in the future.

Other sources of information are as follows:

www.ltsneng.ac.uk = UK teaching and learning support network for engineering

www.ncteam.ac.uk = National Co-ordination Team for Teaching and Leaning in Higher Education in UK

www.compact.org.uk = Computer aided teaching in concrete technology

www.pble.ac.uk = project based learning in Engineering

whurle.sourceforge.net = Collaborative adaptive learning environment

www.macromedia.com/software/authorware/ = Authorware website

www.bodington.org = University of Leeds Bodington open source virtual learning environment

www.webct.com/ = WebCT virtual learning environment

www.jisc.ac.uk = Joint Information Systems Committee (JISC) website - promotes the innovative application and use of information systems and information technology in Higher and Further education across the UK

gideon.mk.dmu.ac.uk/tc/frames/default.html = UK JISC Technology Centre www.techdis.ac.uk = Technologies for Disabilities

www.ilt.ac.uk UK institute of Learning and Teaching

http://info.vhb.org = Virtual University Bavaria (Virtuelle Hochschule Bayern)

http://www.edulinks.de = Non commercial forum for university teaching and internet

http://www.his.de = (Hochschul-Informations-System) An institution founded to provide services for institutions of higher education and departments/ministries of education

http://www.bildungsserver.de = The German Education Server (eduserver) is an information portal maintained by the federal authorities and the sixteen states (the Ländern in the Federal Republic of Germany). The eduserver provides access to information on Education System of the Federal Republic of Germany. The eduserver makes the high-quality information available through a system of databases Internet portal founded by the government.

http://www.progeo-software.de = Software development for the interactive Betonkalender – BK3. An implication of a tool book in combination with new design codes (Eurocode).

4.4 Examples of Applications.

In the appendix I to the Report, 4 examples of applications received from Germany, France and Slovenia are given.

4.5 Summary of Computer Aided Distance Learning

There is, in general terms, an evolution of university teaching from the dominant tradition of lecturing to large numbers of students to more personal contacts in seminars, in small tutorial groups and in design and research projects. Developments in Problem Based Learning are illustrative of this evolution and demonstrate a recognition of changes in students attitudes and skills on entry to university.

In parallel, based on a growth in students' computer literacy skills, computer aided learning is growing rapidly. It provides an independence in the learning process, allowing students to work at their own pace and in their own context. Both of these factors have serious implications on resources, particularly academic staff time.

The "public access" development in computer-based learning materials is welcome and will allow academic staff who's skills are not in this field to adapt packages to their own context and objectives.

In this context of evolution it is essential for all civil engineering departments to establish a specific focus and motivation for change in the ways that degree/ diploma courses are presented.

5. Summary

The civil engineering profession is changing more rapidly than it has even done in the past, in response to world-wide changes. Key new factors in providing the essential infrastructure for modern society are: sustainability, food and water for large populations in need, increasing volumes of wastes and transportation. These difficult areas are made worse by the effects of global warming and climate change and by an unequal distribution of resources around the World.

Changes in the profession demand a breadth of skills beyond those related to the scientific base of the subject, the technical topics, because of the wider impacts of civil engineering projects in modern times. However, continued evolution of those technical topics leads to a demand for more time to be made available for degrees or diplomas in civil engineering. Clearly, this is not feasible and therefore the degree of choice between different subject within civil engineering will need to increase. This is compatible with educational developments being based more on skill acquisition; good basic skills can be used to apply subjects professionally that were not followed specifically in a university course. Later in university courses it is the depth of intellectual experience which matters more than the breadth of subjects studied.

The growing complexity of civil engineering projects requires students to be given the experience of and to develop the skills in team working whilst at university. Note that working in *groups* is not the same a working in *teams* – the latter requires membership selectivity. The key to civil engineering education at university level is therefore providing students with the optimum context in which they can educate themselves in key skills which are transportable. This transportability is in recognition of the pace of change of the profession and the need for young people to be able to adapt to such changes.

When they enter university modern students have significantly different attitudes and skills compared to their predecessors. In many cases there has been limited recognition of these changes by the academic community. The changes imply a need to modify traditional methods of teaching and to focus attention on different learning styles of students based on careful evaluation of those learning preferences.

It is considered that a specific focus for changes to curricula and modes of delivery of educational opportunity should exist in all Departments or Divisions involved with civil engineering education.

Computer Aided Learning is increasing rapidly but is difficult to initiate for academic staff who are not adept in the field. This makes the case for educational software to be more freely available and to be capable of modification locally.

There may be considerable advantage in establishing a European focus for computer aided learning software in civil engineering.

In essence the key factors emerging from the work of Working Group E are:

- a very rapidly changing profession;
- the depth and the breadth of civil engineering are increasing in response;
- the need for transportable, fundamental skills;
- recognition that students on entry have changed significantly;
- evolution of teaching to reflect learning styles of modern students;
- choice in subjects studied, with more focus on skills acquisition;
- increasing use of computer aided learning;
- support for academic staff in the development/adaptation of educational software.

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EXAMPLES OF APPLICATIONS OF COMPUTER AIDED DISTANCE LEARNING

Example 1:

REALISATION OF AN INTERACTIVE CD-ROM 1

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E1.1. Introduction

Traditionally, technical documents were only available as written reports. However, because of the rapid development of new technologies it became possible to present documents in a new way. Computers with fast processors, large memories and storage capacity offer the possibility to provide multimedia versions of any technical document. With help of different elements like interactive tools, examples and animations a better understanding of facts and processes is promoted.

Multimedia technical documents can also easily be distributed on CD-ROM or via the World Wide Web.

In the course of the unification of Europe, national technical documents will be replaced by common European technical documents. This study describes how to produce an interactive CD-ROM, for use by civil engineers who want to obtain extensive information about changes and innovations of the new European design standard "Eurocode 2". The CD-ROM includes all technical possibilities of presenting and teaching the contents of the new design standard. This will lead to a high degree of interactivity and flexibility of the new medium and, as a consequence, the motivation of the user will be much enhanced.

In this paper also experiences made at the "Lehrstuhl für Massivbau der Technischen Universität München" (Prof. Dr.-Ing. Zilch) during the development of multimedia design aids and new methods in presenting and teaching are considered.

E 1.2 The Aims of an interactive CD-Rom

E 1.2.1 General

The interactive CD-ROM is thought to be a medium for civil engineers who deal with the new European design standard Eurocode 2. For the development of the CD-ROM different aims have to be pursued according to the group of users and the following groups can be identified:

- Students
- Inexperienced civil engineers
- Experienced civil engineers

The general intention of the CD-ROM is to promote the motivation and activity of each user to learn and to apply the new regulations of the design standard.

Specific intentions for these different groups are described in the following sections.

E 1.2.2 Students

Several aspects of education and learning are important. As students first have to learn basic principles of design and construction, the major task of an interactive multimedia document is to present all fundamental facts of designing with Eurocode 2 in an extensive way. Learning is a process of development and it is different for each individual. So students should be actively involved in the learning process and that will only happen if they are motivated to do so. Reading printed scripts may be passive, but computer aided learning promotes activity.

Students can use the multimedia document anywhere (at home or at university) to learn or to repeat lectures. Therefore the meaning of an interactive CD-ROM for students consists of a learning module and a reference book, from which they can get and refresh knowledge.

E 1.2.3 Inexperienced Civil Engineers

For civil engineers, who have just finished their studies, it is very important to gain experience rapidly. For this group of users the task to practice can be realized with help of the multimedia package. Practical tips for using Eurocode 2 as well as problems and suggestions for solving problems have to be given. The multimedia document should offer inexperienced engineers the possibility to design structures with Eurocode 2. On one hand the civil engineer will apply the CD-ROM at his workstation as reference book and on the other hand as important tool by using design aids.

E 1.2.4 Experienced Civil Engineers

The multimedia technical document should especially help experienced civil engineers, who have to change from national standards to new European design standards like Eurocode 2. These users must be highly motivated to learn new regulations for design with help of attractive multimedia documents. The interactive CD-ROM has clearly to point out all differences between traditional and future design standards. The experienced civil engineer will use the CD-ROM as reference book, in order to refer to basic regulations of Eurocode 2, as training module, in order learn all changes within the new standard, and as an important implement at his workstation by using design aids.

The following sections refer primarily to the development of an interactive CD-ROM for experienced civil engineers.

E 1.3 Realisation of aims

E 1.3.1 General

The specified aims of an interactive CD-ROM can only be achieved (independent of the user group), if all possibilities of the new medium are used in a reasonable way. The principal aspect for the development of an interactive CD-ROM is a hypertext structure of different documents on it. Hypertext enables information to be stored and presented in manageable sections which can be linked together and searched in any number of ways. It also enables graphics, video, sound and interactive elements to be linked and embedded into the text. Users can recall more information when several of their senses are engaged in the learning process.

The power of hypertext, with its linked structure and electronic indexing, has been demonstrated by the popularity of the World Wide Web.

Reading from a computer screen is less pleasing than reading a book. Consequently the information system on computers must be structured into much smaller units than in printed documents. The best results are achieved with single-screen units without overcrowding the screen.

The benefit of multimedia documents lies in the fact that extensive information can be given by utilizing the memory capacity of the computer and the CD-ROM. It is reasonable to merge all different technical reports concerning Eurocode 2 on the CD-ROM, in order to enable a study of regulations of Eurocode 2 without further printed documents. By linking these different documents, rapid access to needed information can be achieved.

The CD-ROM should not have a pre-programmed sequence through which the user must navigate. Instead, the user himself can determine actions such as clicking and dragging items on the screen with a mouse. Thus the functionality of the multimedia package is very flexible and encourages the user to take active control of the learning process. For an effective multimedia document a careful balance between guidance and freedom of the user must be created.

In the following section different elements are described which can provide a better understanding and illustration of technical facts with help of an interactive multimedia technical document. These elements should be combined equally, in order to motivate all groups of users to learn the regulations and to apply the European design standard Eurocode 2.

E 1.3.2 Text, Diagrams and Pictures

A major task for the development of a multimedia document is an attractive representation of texts, diagrams, pictures and spreadsheets. For this purpose explanatory text must be divided into shorter units to avoid overcrowding of the screen. With the previously mentioned hypertext structure these different units can be linked.

In this respect a representation without scrolling the text is a reasonable means. As pictures (diagrams, spreadsheets) use a lot of space on screen, it is reasonable to substitute these elements with small buttons. By clicking on these buttons the pictures (diagrams, spreadsheets) are rendered in original size. Thus irrelevant graphical elements can also be blanked out in order to facilitate reading of the text and to avoid overcrowding.

Concerning Eurocode 2 the explaining text should give all necessary background information about the regulations of the European design standard. This can happen with help of flow charts (e.g. sequence of a check), explanatory graphics (e.g. stress-strain diagrams), spreadsheets (e.g. material properties), summarized formulae, design charts (e.g. general design diagram) and plain text.

E 1.3.3 Applets and Interactive Tools

In contrast to printed documents a multimedia document provides integrated interactive (graphical) tools. The aim of these tools is to explain complex theoretical facts with animations, graphs, evaluations and parameter studies. These tools offer the possibility to “try” and to understand the verifications of technical documents, such as Eurocode 2. Each of these (graphical) tools is a small applet, which can be started with a mouse click and which can be activated in a separate window.

Different types of illustrative applets are imaginable:

1. One option to visualize technical facts is to use a sequential output on screen. Thereby facts are described by text, pictures and diagrams. The display of these elements on screen changes, when the user is clicking on a “Continue”-Button. These applets are comparable with a slide show. At this level the interactivity of the user is limited.

2. Applets can also be interactive calculating tools. The appearance of these applets is variable:

- Single formulas can be calculated with changeable parameters; the results are represented in graphs, worksheets or spreadsheets.
- Coherent formulas are evaluated as is necessary in design. It is possible for users to survey the results in terms of their varying inputs. Results are given depending on the parameters as values (e.g. required tension reinforcement), as graphs (e.g. stress-strain diagrams) or in form of spreadsheets.
- The computer screen can provide models of the reality in the form of animated, controllable simulations. These animations can clarify, for example, sequences of designing and constructing, sequences of the behaviour of structures while loading, sequences of strain changes in cross sections etc.

A clear structure of the applets should be given to the user. Fig. 1 shows an example partitioning of the display by means of the interactive realisation of the general design diagram:

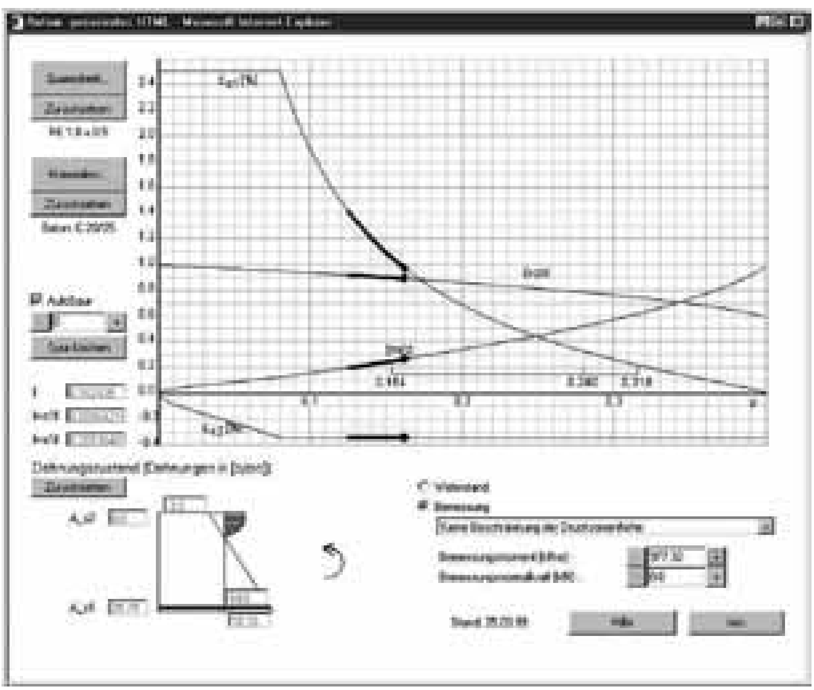

Figure 1. Structure of an applet

The left side contains the input modules for material properties and cross section values. On the bottom right there is the input module for design loads, on the bottom left and on the top right are graphical output sections. Ideally a frameset with an input and output section is used for partitioning.

3. Design aids can be created with help of applets. These design aids, like e.g. design charts for reinforced columns and beams, can be created for any material properties, safety factors and cross sections and then can be printed and used in practice.

4. Video (and sound) sequences can be utilised. But this needs to be handled with care, because the use of video strongly depends on hardware configuration. For acceptance of an interactive technical document, it is very important that everybody can apply all applets in a reasonable way.

These ways of illustrating technical facts and backgrounds are a big advantage, in contrast to printed documents. The motivation and activity of each user can be promoted and the comprehension of difficult technical facts can be facilitated.

The conception of applets must be clearly structured, in order to introduce inexperienced users, step by step, to the subject of the applets. An additional plain tutor guidance or a help function clarify the use of the different interactive modules.

E 1.3.4 Examples

In addition to explaining texts, examples clarify the application of design standards, which is important for all groups of users. Different kinds of examples are imaginable:

Non-modifiable examples: These kinds of example are comparable with examples in printed documents. The user can only comprehend how to apply regulations in the design standard. He does not have an option to change any values or parameters.

Modifiable examples: These kinds of example offer the possibility to modify values in any way or in determined steps. The user can investigate how the results of design and calculations change as parameters vary. If the values are modified in any way, the examples must be combined with a small mathematical programme, which evaluates the relevant design formula. If it is sufficient to change values only in defined steps, all formulae can be pre-calculated and adequate results can be saved on CD-ROM.

Examples in combination with applets: The third kind is a combination of example and interactive applet. On one hand the user can comprehend the application of regulations by reading text, on the other hand he can try and understand the verifications and regulations of design standards (Eurocode 2) in the form of interactive parameter studies and small design programs. The technical realisation provides the possibility to start an applet at an appropriate position in examples using the defaults of the example.

E 1.3.5 Design Standard

Besides explaining reports, illustrating applets and clarifying examples, the multimedia package concerning Eurocode 2 should naturally include the Eurocode 2 standard itself. All these documents are linked together. The user can get quick and extensive information in four ways. Links and references within the design standard should also be realized in order to enable an effective and faultless design of structures.

E 1.3.6 Tutorial, Index

Complementary tools should be provided:

Tutorials on how to apply the different applets, how to find one's way and how to use the CD-ROM must be offered for guidance of users. The tutorial can be started in a pull-down menu or with a "Help"-Button.

In contrast to printed reports it is possible to get requested information very rapidly. The electronic index quotes all positions of corresponding headwords located in the explanatory text, in the applets, in the examples and in the accompanying chapters of the design standard.

E 1.4 Technical Realisation

E 1.4.1 Hardware Configuration and Operating System

The aim of the project is that the multimedia package can run on a maximum number of workstations. But in order to get a reasonable performance minimum and standard requirements concerning processor, screen resolution, version of operating system, colour depth, memory capacity, graphic and sound boards have to be defined. With the definition of these requirements the number of possible users is determined. If the definition of the standard display resolution is too low (e.g. 640x480 pixels) the screen appears overcrowded, if it is too high (e.g. 1600x1200 pixels) the number of users is restricted. Primarily expendable video animations strongly depend on hardware configuration, with the consequence that the user circle of these animations is limited.

It must be determined for which operating system (Windows, Unix, etc.) the multimedia package should be performed. Accordingly, additional programs (e.g. browser) also have to be offered.

E 1.4.2 Computer Language

To retain flexibility to allow updating versions of the multimedia package, all applets and programs should be programmed with fast modern computer languages. An additional aspect is the independence of the operating system. One representative of this kind of language is JAVA. JAVA programs work on different computers with different operating systems. Also the appearance of JAVA programs is favourable, because the display on screen is automatically adapted to the environment of the operating system in use.
The source code of a JAVA program is compiled with a JAVA compiler to a byte code. This byte code is independent of computer and operating system. The byte code is primary interpreted at runtime of the program. Thus JAVA programs are slower than other comparable computer languages, which compile the program code before running the program. For complex and expendable computer calculations and animations, other programming languages like C or C++ should be chosen.

E 1.4.3 Browser

In order to make the multimedia document runable via the World Wide Web, it seems reasonable to utilize a standard web browser for representation of the multimedia document. The most frequently used browsers are “Microsoft Internet Explorer” and “Netscape Navigator”. The multimedia document should work with both internet browsers, but one browser should be selected to provide the best performance, because it is hardly possible to reach an optimum performance for both.

In order to develop a product, which is also executable without technical problems in the future, it must be determined how to handle update versions of the browser. As it is not certain that the product would run faultless with new browser versions, it seems reasonable to perform the multimedia document for one specific version of a browser, which should be offered together with the multimedia document. The user can install this browser version separately as his standard web browser. Thus, on one hand he will get the best performance for the multimedia document by using the browser version of the multimedia package, on the other hand he can use the newest browser version for surfing on the net. If this solution aspired to, “Netscape Navigator” should be preferred, because in comparison to “Microsoft Internet Explorer” it does not interfere with the operating system of the computer.

If the multimedia package is offered with a browser, the distribution and copyright of the browser must be authorized by the distributor of the browser software.

E 1.4.4 Text Editor and Converting Tools

E 1.4.4.1 Overview

The text can be written with help of many diverse writing tools like simple editors (e.g. HTML-editor), professional word processing programs (e.g. Word, WordPerfect) and text systems (e.g. LaTeX). The choice of the writing tools is closely allied to the final display format of the text.

E 1.4.4.2 HTML-Format

One well-known and often used text format, especially in combination with browser environment, is the HTML- format. To get a HTML formatted text, any of the previously mentioned text writing tools can be used:

- With help of a HTML-editor (e.g. Netscape Composer) no further conversion of the text is necessary. The HTML-editor is a very simple text editor, with which plain text and graphic display is easy to obtain.

Also linking of different documents is possible. But there are also disadvantages:
- rendering of complex formulas is not possible;
- no automatic numbering of text sections;
- one's own definitions to page styles are necessary;

- When using other word processing programs or systems like Word, WordPerfect or LaTeX, the written text has to be converted with a converting tool. Many text converters with different converting results are available. Sometimes the following problems exist:

- unappealing rendering of formulas;
- text attributes (e.g. text style, size, colour) are not convertible;
- faulty numbering of text sections;
- converting of formulas and spreadsheets as pictures may result in insufficient or none size modulation when the text size settings change
- syntax of links and targets

Many HTML-converters can be downloaded from the World Wide Web. In new Word and WordPerfect versions it is already possible to save written files in HTML-format.
Also LaTeX to HTML converters are offered on the World Wide Web.
Amongst others there are two main LaTeX converters:

LaTeX2HTML: This converter is a well-known tool, which provides appealing results with regard to a faultless converting of the LaTeX source text. This converter splits one document into many small documents, each consisting of one section of the source document. A disadvantage is the conversion of formulas and sysmbols, which are rendered after conversion as pictures. If a user changes the text size settings, the formulas and symbols will not be modified.

TtH: This problem does not exist with the TtH-converter. All formulas and symbols are converted as letters, which are modified when changing text style settings. In contrast to LaTeX2HTML the TtH converter does not split a document. The conversion result is one HTML file.
In order to support links between different components of the multimedia package (text, standard, applets), new LaTeX command definitions have to be defined.

E 1.4.4.3 PDF-Format

Another way to publish documents on a computer is the Portable Document Format (PDF) of Adobe. PDF has several benefits:

- PDF was specifically designed as document distribution and archive format.
- PDF viewers and printing tools such as Acrobat Reader or GhostScript are freely available.
- PDF allows the inclusion of hyperlinks.
- PDF allows one to include graphics very compactly with JPEG.

Because of these advantages the PDF-format is at the moment one of the most popular and most used text formats.

E 1.5 Structure and Layout

In order to enable a comfortable and plain application of the whole multimedia document, the package must be clearly structured. For ease of application, known elements of a standard computer desktop should be used on screen as much as possible, like:

- pull-down- menus,
- help functions,
- mouse functions (right/left mouse button),
- navigation units,
- windows,
- scrolling,
- maximize, minimize- and close-buttons for windows and
- display of links with blue colour.

With help of a consistent, clear and confident structure the inexperienced user is also encouraged to apply the multimedia document. The information units have to be structured into much smaller units than in printed documents, in order to make reading from the computer screen attractive. For a clear representation a frameset should be used, which comprehends the structure in one frame and the text, applets etc. in other frames. The user should always know his current position in the structure tree.

The elements of the multimedia package (explaining report, applets, examples, standards) should be represented in different styles, in order to clarify which part of the multimedia document is activated at the moment. There are various options to signify documents:

- type size and type colour;
- fonts;
- colour of background;
- presentation in frames and windows.

An example of different elements like structure, buttons, pull-down menus and text is shown in Fig. 2.

Figure 2. An Example Screenshot

The display in Fig. 2 has two major elements. The frame on the left contains the Structure with the current position is coloured blue. The frame on the right contains the technical text. On the top and on the bottom of the right frame further buttons for the electronic index, table of symbols, list of literature and links to other documents of the package are arranged. In order to enable the display of two different documents on screen at the same time (e.g. applet and Eurocode 2), each different document of the multimedia package should be activated in a separate window. With regard to a usage via the World Wide Web all desktop elements should be arranged and represented in World Wide Web usual style.

E 1.6 User Guidance

One method of encouraging users in active learning is to invite them to explore and discover for themselves. The user should be empowered to take active control of his learning process and of choosing which problems to solve and what information to get. To enable this learning process a careful balance between freedom and guidance should be maintained by the program. On one hand the multimedia document should not have a predetermined sequence through which the user has to navigate. On the other hand the functionality of the multimedia package should not be too complex, in order not to overawe the user.

With help of the previously displayed structure in the left frame the user can navigate through the whole multimedia document (text, standard, example). The other way to change between different documents is to use lines in the text. In doing so the new position in the structure tree must be shown in the left frame to maintain the orientation of the user. In order to change rapidly between already presented pages, „Forward"-and „Back"-Buttons should be arranged. An other way to reach a special page is to apply the electronic index. For the composition of the different elements it should be considered which documents and programs should be linked and how many links exist. With an increasing number of links the complexity of the multimedia document increases and the orientation becomes more difficult.

E 1.7 Cooperation and Organisation of Task Groups

The development of a multimedia document can be split in the following task sections, which can be addressed by different task groups:

1. **Development of applets and programs**: requires skills in programming and presenting on screen
2. **Hypermedia, composition of all file**s: requires knowledge in hypermedia, browser environments and converting tools
3. **Text, pictures, graphi**cs: requires knowledge of technical facts.

A further splitting of task sections does not seem to be reasonable, because otherwise the different sections strongly interfere between themselves. On the other hand it is also imaginable to split the project only in a technical realisation and a text part.

In order to enable a successful cooperation of all groups, the tasks of each team have to be defined exactly. For interdependent tasks the interfaces between the teams have to be clearly determined.

Example:

The usage of links, such as the basis for hypermedia, concerns two different task groups. The "text team" constitutes the position of links and targets.

The "computer team" has to determine the syntax of links and targets.

To save a trouble-free cooperation and communication between the task teams, considerations concerning the communication ways (internet, intranet, news-groups) have to be made. The interchange of all teams is very important.

On one hand the task teams can control each other, on the other hand a successful process of development can only take place with adequate communication between all groups.

Another option of task sharing is to allocate the programming part to a professional software firm to develop all applets and programs. In addition to the multimedia package, professional engineering software such as design programs can be put on the CD-ROM by the software firm.

E 1.8 Additional notes

For the production of a multimedia document on a CD-ROM several further aspects should be considered:

1. With regard to developing a multimedia document covering the European design standard, Eurocode 2, the package should be offered in different languages. This enables an application in all European countries. The optimum solution of this aspect is to create only one package, in which the user can decide the country and language default by clicking on a „Country“-Button. In addition to the language all additional national technical application rules of the respective countries can be modified by clicking on the „Country“-Button.

2. The multimedia package should include a comfortable set-up routine. As a consequence inexperienced computer users do not have to worry about installing the package.

3. In order to restrict unlicensed copying, several possibilities of protection are imaginable:

Measure	*Advantage*	*Disadvantage*
Hardlock (Dongle):	High protection	Inflexible; problem with multi user licenses
Registration number:	Flexible;	Low protection
Registration in combination with serial number of computer	High protection	Only useable on one computer

4. If additional commercial programs or reports are to be offered with the multimedia package, the distribution and copyright must be authorized by the respective distributor or author.

5. In order to get a high quality product determinations about controlling and testing should be made. Already during development the particular parts of the multimedia document should be currently checked by the members of all task groups. When a first version (beta-version) of the whole package is finished, external controlling groups should also be involved in the verification process.

Thereby the following aspects should be especially considered:

- User guidance
- Checking of links
- Function of applets and programs
- Layout

6. Depending on the kind of distribution (CD-ROM, WWW) a concept of sale should be considered (price, number of units, etc).

7. In this regard it should also be clarified how to handle future update versions of the multimedia package.

8. In order to get feedback to improve future versions and in order to support users, a hotline service or an e- mail service should be provided.

E 1.9 Costs

The total costs for the realisation of an interactive CD-ROM naturally depends on the extent of the whole project. If the interactive CD-ROM comprises all previously mentioned elements, the following technical tasks for the realisation have to be performed:

- Formatting the representation of text, examples and standards
- Realisation of hypertext structure
- Programming of applets and tools
- Integration in a browser environment

For these points of the technical realisation the following conditions are presumed:

- All texts (explaining text, examples, standard) and all pictures exist in any file format.
- All sequences for applets exist as drawings or explanatory texts.
- The task group for the technical realisation has extensive knowledge in hypermedia, browser environments, converting tools and programming (JAVA).

Under the condition, that all these mentioned aspects are fulfilled, the costs for the part of technical realisation amount to a minimum of 150.000 EURO.

E 1.10 Conclusion

The previously mentioned facts about realisation of a multimedia document are based on experience gained at the “Lehrstuhl für Massivbau der Technischen Universität München“ (Prof. Dr.-Ing. K. Zilch). They point out a number of important aspects, which have to be considered carefully when developing an interactive multimedia document.

Example 2:

IMPLEMENTING 3N: A NEW TECHNOLOGY, A NEW SCIENCE, A NEW TEACHING METHOD

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E 2.1 Introduction

Eight years ago, the Ecole Nationale des Ponts et Chaussées (ENPC) opened a course in urban hydrology. This course aims at teaching the tools, the methods and the concepts of this new science. It is opened simultaneously to engineering students, with a mathematical background and students from a 1-year postgraduate diploma in environment with a background in biology and earth sciences.

A pedagogical approach in urban hydrology has to deal with several challenges. It must be able (1) to transfer new and ever evolving concepts to the students, (2) to cope with multi-disciplinary problems, (3) to combine scientific fundamentals and professional applications.

On this basis, the web learning environment enables (1) the multiplication of information sources and their rapid updating, (2) an opening onto the professional sector, (3) a greater flexibility in learning which is of primary interest for a heterogeneous audience.

After a short presentation of the specificity of urban hydrology, we will present how the web and distance learning was added to traditional contact hours.

This pedagogical form has now been operating since 1997 and it has become possible to draw preliminary conclusions and perspectives.

E 2.2 Scientific and Technical Context

Urban hydrology deals with the part of the water cycle which modifies or is modified by the functioning of urban areas, drinking water excluded. It has been considered as a science and not only as a technique since the beginning of the sixties when a research programme lead by the American Society of Civil Engineers was launched. More recently, a joint committee which depends on both the International Water Association (IWA) and the International Association for Hydraulic Research (IAHR) was created at the end of the eighties, which organises an International conference every three years.

This thirst for scientific independence was motivated by the following points:

- Because of the small size of urban watersheds, critical rain events being shorter and more intensive differ from those studied in hydrology;
- The runoff process is highly modified by the imperviousness of urban areas, which leads to less infiltration and higher peak flows;

- The artificial character of drainage networks;
- The specific vulnerability of urban areas regarding flooding with its human, economic and environmental consequences;
- The rapid increase and modification of urban areas which leads to inhomogeneous time-series and the difficulty of using historical time series for statistical assessment;
- The modification of the perception of water by the urban citizen.

Moreover, identifying this new scientific field and obtaining relevant research results leads to a rapid transformation of the professional in the fields of sanitation and waste water treatment.

Previously, the background curriculum of the sanitation engineer was mainly civil engineering. Now the complexity of a sewer system and its impact on the environment needs engineers with a much a broader point of view and with a mastery of numerous fields ranging from environmental engineering to electronics.

New scientific tools and especially modelling are now widely used, and both water quality and quantity are widely surveyed.

One of the most outstanding consequences of the creation of urban hydrology is the recent shift in the underlying paradigm concerning runoff water, which shifted from an objective of maximising peak flows at the sewer system outlet in order to evacuate the water as rapidly as possible to that of controlling the flow at the outlet while keeping it to reasonable values in order to minimise the impact on the receiving system optimising the cost of the sewer system infrastructure. This is achieved by keeping the water in the upper parts of the watershed in detention ponds or by infiltrating it.

Thus we are moving from a regulatory and normative approach (protection against a 10 year return period rain) to a risk management approach, the level of protection being discussed between all the relevant stakeholders.

Within this scientific and professional context, a educational approach has to cope with the following points

- Explaining the recent paradigm development
- Developing the inter/multidisciplinary attitude
- Enabling the student to master future changes.

E 2.3 The pedagogical context

The learning objectives were designed as follows:

- To analyse the various objectives of a sewer system;
- To situate the urban hydrology and the sanitation in the context of other urban techniques and sciences;
- To explain the state of the art and the future trends in the design and the management of sewer systems.

The various lessons are organised in order to show an idealised attitude of a multidisciplinary engineer facing an urban hydrology problem. The first part of the course is dedicated to the design of sewer systems, and the second one to their management with specific emphasis on runoff water.

As urban hydrology has to cope with integrated approaches, a multi-disciplinary context, and the latest up-to-date research results, it was decided to simultaneously run a project, adapted from a real case, in which the students have to design a sanitation system on a small watershed. Through this project, the students are able to apply the concepts, the methods, the tools presented during the course, and to adapt them to a real problem.

The main outcomes of this project are that:

- there are several solutions to an engineering problem;
- the consistency of the proposed solution, on the basis of existing documentation is the most important fact.

Through this project the students will also learn what the work of the engineer really is, i.e. trying to offer one or more technical solutions to a problem which is asked for by society.

E 2.4 A Web Based Learning Environment (WBLE)

NTE is an interesting tool for applying the learning objectives mentioned above:

- They enable interactions between teachers and learners, through emails or forums, outside the teaching hours;
- They open the class towards the real world, facilitating contacts with professionals and widening points of view through relevant links;
- They enable personalised learning. Concerning multidisciplinary learning, students often have heterogeneous levels. With web based learning, it is possible for students to control their own rhythm of learning;
- A WBLE includes not only written materials but also voice, video, images, which are sometimes more efficient for knowledge transfer.

Concerning our urban hydrology course, the following topics, from simple to more complex practices, were implemented:

- Lecture notes;
- Drill exercises. This part enables basic scientific learning and assessment. Classical MCQ hinders the professor in locating mistakes made by the students through the process. Thus we propose simple exercises whose answers are e-mailed to the professor. A solution is put up on the web, which stresses not only the results but also the main mistakes encountered. In case of specific errors, the professor sends a personal email.
- A role game. Vilegout is a synthesis exercise concerning drainage system design. Students, as consultant engineers, have (1) to understand the drainage system of a city (2) to adapt it to newer urban conditions (3) to propose their own.

Their initial knowledge of the case study is really limited, and they have to ask he professors relevant questions. Thus a dialog is opened on an internet forum for a 3-week period. Each student has a capital of ten questions. Finally, students have to present and justify their proposal. The assessment is based not only on the final proposal but especially on the relevance of the questions.
- A final project is proposed as synthesis work. The web environment is then used as an information base. An Encyclopaedia in urban hydrology has been set up. Moreover, through the mail, students have the opportunity to contact other experts in urban hydrology in order to widen their view angle and their perception of multi-disciplinary work. A links data base is also at their disposal.

E 2.5 Conclusion

After a 3-year experiment, we and the students consider that the use of the web environment has been really positive.
- The combination of written material and simple exercises makes the learning easy and efficient. Contact hours are fully used for knowledge transfer and exchanges between teachers and learners.
- Both the role game and the final project are very flexible. The students are able to express their creativity and their innovation capability. This creativity is also enhanced through the links available on the web site.
- Using an electronic forum is a good way for maintaining contacts and exchanges between the class hours and to reinforce them without any agenda problems.
- WBLE is really easy to use and students are interested in this way of learning and are thus more motivated.

We have now to jump to a second level. The following directions are under study: (1) to decrease contact hours, considering that the lecture notes and the drill exercises are a satisfactory combination; (2) to transfer most of the existing material from the web to a CD-Rom considering that internet access is still not easy, the web environment being kept mostly for interactive purposes; (3) to transfer and adapt this approach for a continuous education project within the frame of lifelong learning.

Example 3:

A TOOL TO COMMUNICATE EMPIRICALLY BASED KNOWLEDGE IN EARTHQUAKE ENGINEERING

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E 3.1 Introduction

The current procedures in earthquake resistant design have been developed during an evolutionary process based on the observed behaviour during strong earthquakes. There is another aspect of these lessons, which may perhaps be even more important than the knowledge ultimately built into equations - the feeling for the behaviour of structures. This feeling can be gained by going to earthquake sites, which is an expensive and rare experience or to visit lectures, where engineers who did see the damaged area, share what they saw with the audience, usually by showing slides or video movies.

During his twenty years of teaching experience, the first author has realised several impediments of such approach. The lectures are fixed in time and space. It is difficult for audience to maintain concentration and make notes in the deemed light environment. The background and interest in the audience typically differ from person to person and it is difficult to formulate the appropriate level of additional explanations. Up to recently, the only alternative has been to either prepare copies of slides with commentaries, or print reconnaissance reports. Both are typically very expensive. In addition to this, printed material should always follow a predefined concept (by the type of structure or by the type of material for example). It is frequently difficult to look over such material and cross-references are typically tedious.

Modern information technology provides, however, an excellent opportunity to disseminate such empirical knowledge. The Web certainly encourages new ways of publication and enables inexpensive publishing of content, which could not been printed on paper. As an example, the presented earthquake engineering slide information system EASY[1] was developed. While the detailed description of the system can be found elsewhere[2], only a short summary precedes the sample session with EASY in this presentation. The session demonstrates typical usage, capabilities and educational potential of the system.

E 3.2 Basic Information About the System

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 data bases 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[2]. The system is available on the Web and on the CD-ROM.

E 3.3 Sample Session with "EASY"

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 (Fig.1). The large number of related slides is indirectly indicating the importance of the investigated topic. The list includes small images, short captions and the identification of the earthquake.

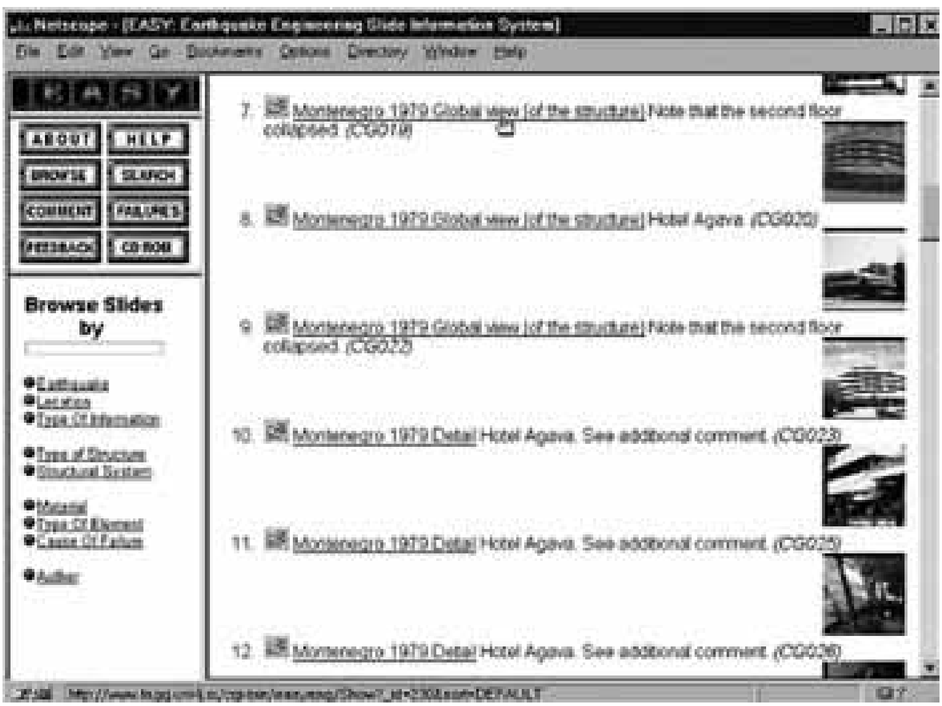

Figure 1. Typical results of search or browse command

The collapsed building of the 9th image on the list may draw the user's attention and he/she can choose this particular slide for more detailed investigation. The information about the chosen slide is displayed (Fig. 2).

This is the central page of the information system. In addition to the basic information about the slide, it provides links to more detailed comments on:

- the building and its behaviour (global comment No. 56)
- (three) main causes of failure (failure comments No. 6, 21, and 22),
- as well as the links to related slides.

By choosing relevant comments, the user may get more detailed information about the cause of failure that he/she is studying 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 (Fig. 3). From here the user can take even closer look of the detail on slide No. 242 (Fig. 4). 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” (Fig. 5). In addition to the purely technical information, this comment, for example, 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 in Figure 2

Figure 4. Closer look of the detail from Figure 3

E 3.4 Application of the System

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.

Figure 5. Failure comment with "Find related slides" option

E 3.5 Future Development Plans

Empirically gained knowledge is of course only a part of "complete" knowledge in earthquake engineering. Therefore, a broader information system is being developed. It combines four basic components of technical knowledge: (a) theoretical background and analytical procedures, (b) numerical example, (c) technical standard in hypertext and (d) slide information system EASY. All four components are related with hypertext links (Fig. 6).

E 3.6 Conclusion

The Web encourages new ways of publication and enables inexpensive publishing of content, which could not been printed on paper. Realizing this opportunity, a tool for teaching earthquake engineering was developed. It has proved to be efficient to convey empirically based knowledge, which is typical for (earthquake) engineering.

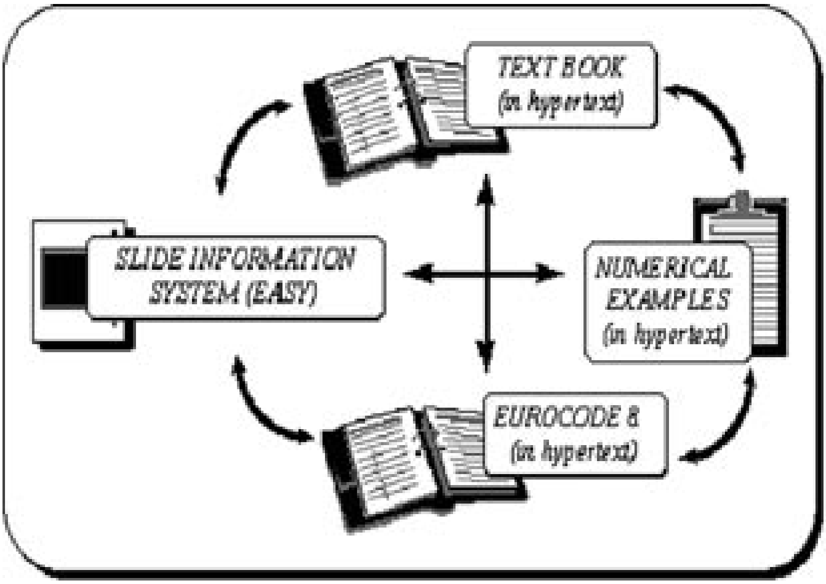

Figure 6. Computer supported teaching and advisory system

E 3.7 References

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2. Fischinger, M., Cerovšek, T., Turk, Ž., "EASY: a hypermedia learning tool", Electron. j. inf. tech. constr., 1998, Vol. 3, pp. 1-10.

Example 4:

ACCELERATED DEVELOPMENT OF WEB BASED TEACHING AND LEARNING ENVIRONMENTS

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E 4.1 Introduction

In addition to the pedagogic work, a university teacher is also tied up in several administrative works, such as specifying the dates for exams, making the lecture schedule available, consulting with the students, etc. Some of the technical burden can be relieved by information technology (IT), particularly when the tasks are related to disseminating information (teaching materials, schedules, lecture notes, announcements, grades, exam results etc).

In this paper, a solution is presented that enables rapid development of Intranets that support an educational organisation such as a faculty. Establishing such an Intranet is fast. There is no programming required. It is inexpensive because only free software is used and modest hardware is required. It is easy to use because its entire user interface is through a Web browser. The complexity of Web publishing is hidden from the teacher.

E 4.2 Problem statement

The potential users of the Intranet include professors, students and external users (speaking native or foreign language). The use cases are shown in Fig. 1.

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.

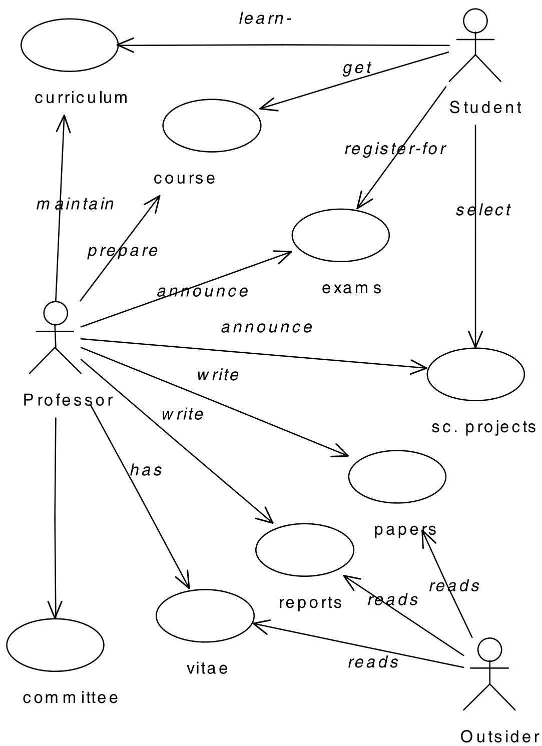

Figure 1. Use case diagram

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.

E 4.3 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[1]. WODA is a CGI application written in Perl language (Fig. 2). 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 outweigh 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.

```
#
# Database definition:
#

$WBB{'dbTitle'} = 'Units and Chairs';
$WBB{'about'} = 'The database contains information about chairs and
other research and teaching units of the Faculty of Civil and
Geodetic Engineering.';
$WBB{'recordTitle'} = 'Unit';
$WBB{'language'} = 'uk';
$WBB{'dataDir'} = '/users/zturk/fgg/htdocs/db/units';
$WBB{'homeURL'} = '/db/units';
$WBB{'sort;DEFAULT'} = '"$rec{acronym}"';
$WBB{'format;DEFAULT'} = '$rec{homePage} ? "<B><A
HREF=$rec{homePage}>$rec{title}</B></A>" : "<B>$rec{title}</B>"';
$WBB{'key'} = '"$rec{acronym}"';
$WBB{'requireFile'} = 'common.uk';

#
# Field definitions:
#

$i=1000;                    # counter


$x='acronym'; # ------------------------------
$WBF{$x,srt}=$i--;
$WBF{$x} = 'm/[A-Z]{1,8}/';
$WBF{$x,'cond'} = '1-8 velikih crk angleske abecede';
$WBF{$x,'typePar'} = 'SIZE=8';
$WBF{$x,'help'} = 'Vpisite <I>slovensko</I> kratico enote';

$x='title';       # ------------------------------
$WBF{$x,srt}=$i--;
$WBF{$x} = 'm/.{5,80}/';
$WBF{$x,'cond'} = '5-80 znakov';
$WBF{$x,'help'} = 'Vpisite naziv enote v anglescini.';
```

Figure 2. Part of a sample database definition

E 4.4 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 or 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 Example 3.

E 4.5 Reference

1. Turk, Z., WODA-Web Oriented Database, http://www.fagg.uni-lj.si/~zturk/works/wb/, 1.1.1998.

DEVELOPMENT EXAMPLES

Four Universities have provided input on historical developments over various period of times. These are presented in the following as described by representatives from the different universities. Time frames, division of subjects, as well as format of presentation vary due to the various structures, study programmes layout and changes implemented over the time considered.

1. Norwegian University of Science and Technology, Norway

The information given is for Structural Engineering Curriculum at Faculty of Civil and Environmental Engineering.

In 1997, the study programme was changed from 4 1/2 years to 5 years. The data given shows the percentage of studies within the first three years of study, following the ABET Criteria for Accrediting Engineering Programs.

Structural Engineering Curriculum
Example, three first years.

	1980	1990	2000
Mathematics and basic sciences (compulsory)	25%	26%	29%
Core engineering subjects (compulsory)	23%	26%	21%
Applied engineering subjects (compulsory)	15%	35%	29%
Humanities and social sciences (compulsory)	6%	9%	13%
Optional subjects	31%	4%	8%

For structural engineering at our Faculty, this historical development shows some significant changes, while other aspects have been kept fairly constant.

Mathematics and basic sciences show actually a small increase from 1980 to 2000. Core engineering subjects are fluctuating somewhat, with a peak in 1990. The most marked changes are in the applied engineering subjects, showing a dramatic increase from 1980 to 1990. However, in 1980 there was a large volume of optional applied engineering subjects, while this was much less in 1990. Humanities and social sciences have had a steady increase, reflecting the importance put on these aspects in today's engineering curriculum.

As mentioned, the optional subjects in 1980 were high, representing about 31% of the total time. The majority of these subjects were in applied engineering subjects, and to a lesser extent in core engineering subjects. In 1990 this had changed to a very small amount of optional subjects, still mostly in applied engineering, while 2000 showed a rise in optional subjects, now with more equal choices between core and applied engineering subjects.

2. University "Politehnica" Timisoara, Romania

Within the 4 1/2 year study programme (followed by one semester entirely devoted to the Diploma project), the following figures are valid from 1995 up to present days.

Civil Engineering Curriculum
Example, four and half years.

Mathematics and basic sciences (compulsory)	min 18%
Core engineering subjects (compulsory)	min 30%
Applied engineering subjects (compulsory)	min 30%
Humanities and social sciences (compulsory)	min 8%
Optional subjects	min 10%

3. University of Architecture, Civil Engineering and Geodesy, Bulgaria

The following table shows the development from 1982 for the 4 1/2 year (9 semesters) study programme.

Structural Engineering Curriculum
(9 semesters)

	1982	1992	2000
Mathematics and basic sciences (compulsory)	21.8%	21.1%	20.3%
Core engineering subjects (compulsory)	25.4%	24.5%	25.0%
Applied engineering subjects (compulsory+elective)	38.3%	46.7%	45.3%
Humanities and social sciences (compulsory+elective)	14.5%	7.7%	9.4%
TOTAL	100%	100%	100%
Optional subjects (as % of the total time)	0.0%	1.2%	4.0%

The following **remarks** could assist in analysing the above data:

1) The large percentage of humanities/social sciences in 1982 has to be attributed to the imposed state-wide requirements for compulsory political studies promoting the communist ideology. After the political changes in 1989/90, these courses were removed from the curricula and the current situation (9.4%) reflects the increased emphasis on foreign language training and addition of new one subjects such as macroeconomics.

2) The very large percentage of applied engineering subjects could be explained by the presence of compulsory subjects such as ”Architecture”, ”Architecture of buildings”, ”Water supply and sewerage”, ”Road construction”, ”Railway construction”, etc., that are not crucial for the structural engineering but remain, by tradition, in the curriculum, and are meant to provide ”broad profile” graduates. The increase in percentage (comparing year 2000 to year 1982) is mainly due to the fact that the majority of the newly introduced elective courses could be classified as applied engineering subjects, but this is not valid for all of them (e.g. ”Management of construction firm”, or ”Introduction to real estate”). Some of the IT-related courses include both ”math and basic sciences” and ”applied engineering subjects” topics.

Conclusions

- Mathematics and basic sciences show a slight decline from 1982 to 2000.
- The core engineering subjects are maintaining the 25 % level.
- The applied engineering subjects make up the major portion of the curriculum thus reflecting the current situation of turmoil and restructuring within the design and construction industry when very few of the students can rely upon systematic ”in-company” training after graduating.

Trends in civil engineering education

In the wider context of the evolution of our courses, the following factors are seen to be most important in relation to future developments:

- Reduction in the total teaching hours per week, not satisfactory yet;
- Increased application of professional software in teaching and course project elaboration;
- Applied engineering subjects to place more emphasis on the achievements of European research and Eurocodes;
- Lecturers in applied engineering subjects have streamlined the delivery of factual knowledge, trying to develop students’ engineering feel and relate the content more closely to the products offered/available on the market;
- More emphasis on earthquake engineering, theory of stability and advanced materials;
- The evaluation system is switching from the traditional written + oral examination toward test form but very slowly as yet;

- Industry, being in stagnation, is not willing to cooperate with the higher education institutions and the universities face difficulties in establishing long- term partnerships.

4. University of Liège, Belgium

First two years are common to all branches of Engineering.
The courses are here classified according to the categories agreed upon within Working Group A in EUCEET:

A. Basic sciences (Mathematics, Physics, Chemistry)
B. Engineering Sciences (Mechanics, Strength of materials, F.E.M., Computer science,…)
C. Core Civil Engineering subjects (Statics, Dynamics, Hydraulics, Soil mechanics, Fluid mechanics, Building materials, Surveying, …)
D. Engineering specialization (Steel structures, Reinforced concrete structures, Earthquake engineering,…)
E. Economics and Management studies
F. Humanities, Social sciences, Languages, Physical education
G. Field work
H. Final project

Civil Engineering curriculum at the University of Liège over 35 years.

1965 – 1966

	Year 1	Year 2	Year 3	Year 4	Year 5	Total per subject	%
Subject A	231 + 287	180 + 243	15 + 10			426 + 540	23
Subject B		59 + 78	231 + 240	45 + 0	45 + 16	380 + 334	17
Subject C			181 + 204	321 + 438	136 + 610	638 +1252	45
Subject D				15 + 20	60 + 96	75 + 116	4
Subject E					45 + 0	45 + 0	1
Subject F	30 + 0	40 + 0				70 + 0	2
Subject G	0 + 8	0 + 8				0 + 16	
Subject H					0 + 300	0 + 300	7
Total per Year	261 + 95 = 556	279 + 329 = 608	427 + 484 = 881	381 + 458 = 839	286+1022 = 1308 (!)	1634+2548 = 4192	
Opt. hours		27 + 36		15 + 20		42 + 56	2
Opt. courses		2/5		1/3		3/8	

In each cell of the table, the first number represents the lectures; the second one, the problem solving, laboratory or exercises hours.

1980 - 1981

	Year 1	Year 2	Year 3	Year 4	Year 5	Total per subject	%
Subject A	275 + 283	184 + 206				459 + 489	24
Subject B		68 + 84	238 + 253		15 + 0	321 + 337	17
Subject C		20 + 20	165 + 236	314 + 471	38 + 162	537 + 889	36
Subject D				45 + 50	180 + 165	225 + 215	11
Subject E				37 + 8	70 + 0	107 + 8	3
Subject F	40 + 0	10 + 7				50 + 7	2
Subject G	0 + 8	0 + 8				0 + 16	
Subject H					0 + 300	0 + 300	7
Total per Year	315 + 291 = 606	282 + 325 = 607	403 + 489 = 892	396 + 529 = 925	303 + 627 = 930	1699+2261 = 3960	
Opt. hours		20 + 20		45 + 50	180 + 165	245 + 235	12
Opt. courses		1/3		2/8	8/62 (!)	11/73	

2000 - 2001

	Year 1	Year 2	Year 3	Year 4	Year 5	Total per subject	%
Subject A	285 + 280	230 + 220				515 + 500	26
Subject B		80 + 100	185 + 194			265 + 294	14
Subject C			175 + 207	390 + 325		565 + 532	28
Subject D				60 + 60	225 + 255	285 + 315	15
Subject E	30 + 0	20 + 0	15 + 0	30 + 0	30 + 0	125 + 0	3
Subject F	50 + 0	50 + 0				100 + 0	2
Subject G		0 + 8	0 + 60	0 + 60		0 + 128	3
Subject H					0 + 300	0 + 300	7
Total per Year	365 + 280 = 645	380 + 328 = 708	375 + 461 = 836	480 + 445 = 925	255 + 555 = 810	1855+2069 = 3924	
Opt. hours				60 + 60	225 + 255	285 + 315	15
Opt. courses				3/9	17/39	20/48	

The time devoted to the “Final project“ or “Graduation work“ is estimated at 300 hours.

The last two lines of each table concern the options.

- The “Optional hours“ are already included into the “Total per year“; they are nevertheless repeated because they represent the freedom allowed to the students.
- The ratios under “Optional courses“ represent the number of courses to be chosen over the number of optional courses; these represent the diversity of the offer.

Comments
One can observe a status quo for the Basic sciences. There are two reasons:

- The subjects themselves undergo little change.
- The courses being common to all engineering formations, changes require a large consensus which is difficult to reach, while changes in specialty courses are decided by smaller and more dynamic groups.

General engineering formation has progressively decreased from 17 to 14%. Professors of Civil engineering tend to believe that their own specialty courses are more important than general subjects such as Electricity, Automation, Applied thermodynamics,…

Core Civil engineering subjects have decreased from 45 to 28% but that is to free space for Civil Engineering specialization, which has increased from 4 to 15%. The total has slightly decreased: from 49 to 43%.

Specialization within Civil Engineering represents the most significant change. It has mainly been obtained by means of optional courses, which have increased from 2 to 15%. This at the cost of an excessive number of courses: they have jumped from 8 to 48 with a peak of 73 in 1980! Every professor or senior staff member has introduced one or two courses about his pet subject!

To fight the dispersion, a modular system has been introduced.

The total time devoted to Economics, Humanities and Field work has increased from 3 to more than 8%. Many believe it is still far too little.

In the 60's, much time was devoted to comprehensive projects, such as a bridge or a lock, where some sort of teamwork was present. Over the years, they have been replaced by smaller individual exercises. One would like to reverse this trend but it has become difficult because of the parcelling of the academic charges.

A successful change introduced since 1991 in the teaching schedule of the final year seems worth sharing.

It is assumed that all basic subjects have been covered in the first 4 years and that the 5th year is devoted to specialized subjects. The purpose is not to fulfil specific needs (probably only a few of the graduates will apply these materials) but to show the students how to go fast and deep in some directions.

The academic year is divided into short teaching periods, called modules, 3 or 4 weeks long. During each of these periods, only three courses are taught but in a very intensive way, especially during the first week; during the second week the balance is between lectures and tutorials; during the last week, the students spend most of their time on exercises, small projects and preparation of the oral exam. This exam takes place on the last Saturday of the module, in front of a small jury composed of the three concerned professors.

The students are confronted with examples of advanced material; they learn how to work under short-term pressure and to integrate at least three subjects. The division into modules enables them to go abroad for 3, 6, 9 or 12 weeks without missing a fundamental subject and without having to catch up with their friends. This flexibility is convenient for Erasmus exchanges because teaching periods in different countries seldom coincide.

Appendix III

ENCOURAGEMENT OF CREATIVITY

It appears from general enquiries amongst the members of Working Group "E", that there are few examples of courses within Civil Engineering specifically designed to encourage innovation or creativity skills in students. This example, from Imperial College, London, illustrates a series of interconnected courses designed specifically to encourage students to develop their creative skills. It is part of a four year course structure for students reading for a degree in either Civil Engineering or Civil and Environmental Engineering.

Year 1. Creative Design (1)

Project based: includes – write a design brief, brainstorm design solutions, make creative designs, recognising a good design, develop a design idea so that it is practical, affordable and, hopefully, elegant.

Simple Object design exercises: a CD cover, a chair, a house ……

Format: three hour sessions in a design studio/workshop with regular criticism session ("criticism" of self, of others and by others).

Developing a portfolio which is added to throughout the three integrated years of this course. Lots of sketching in design development

Materials: architects butter paper and felt-tip pens only.

Learning Outcomes*:

- Creativity, clarity and confidence

Means: practise and feedback, continuous constructive criticism

Year 2. Creative Design (2)

Again project based including the components on Creative Design (1) but with more complexity. Key themes are: constructability, sustainability and affordability. Individual and group working, continuous constructive criticism and assessment.

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* Note: Learning Outcomes are defined for all course in Civil and Environmental Engineering at Imperial College and students evaluate the extent to which those outcomes are achieved in every course.

Learning Outcomes**:

- Further development of creativity, clarity and confidence.

Means: practise feedback and continuous constructive criticism.

Year 3. Group Design Project.

This is a full-time five week activity in a design studio/workshop context with continuous constructive criticism (of self, of others and by others). It involves team working and communication skills. Strong pressure on the students for initiatives and innovation.

Components: Synthesis of design ideas, holistic engineering design, form-guided design, environmentally aware design, materials choices. Study of options and choice.

Topics selected from, typically, a bridge, a hydro scheme, a light railway, an offshore oil rig, land reclamation, a tower, a canal basin, an underground railway station.

Learning Outcomes:

- Team working and communication within a group and with third parties
- Interpretation of a design brief
- Developing a project from a brief
- Iterative exploration of design proposals.

The course is managed by a part-time Professor who is a senior designer in the profession and works on the interface between civil engineering and architecture. He is assisted by members of the academic staff and by visiting staff from leading design consultancies. Students will often seek meetings with experts in the profession and on the academic staff to discuss their design development – again based on constructive criticism.

** This course is paralleled by specific design projects, typically of two days each, e.g., a penstock for a hydro power scheme, column design for stability and a structural steel design. This is much more specific and typical of the more usual design exercises.

Appendix IV

A SIX HOUR PROBLEM SOLVING MODULE

This is an example of problem-based peer learning as an alternative learning tool for acquiring social and managerial skills deemed necessary for today's student engineers carrying out professional internship abroad.

Participants
The following module is offered to groups of 12 engineering students in their second year at l'Ecole Nationale des Travaux Publics de l'Etat (Lyon, France) prior to a two month professional internship at home or abroad. The students are aged between 21 and 23 with a gender mix of approximately 25% female to 75% male. There are 2 contact hours per week. There is little linguistic competence streaming in a bid to reflect the real world of international meetings.

Objective
The overall objective of this short E.F.L. module is to offer the learners an opportunity to reduce the gap between what they want to communicate and what they can communicate in a simulated professional situation where the following skills were targeted:

- Real World Problem solving
- Meetings Participation
- Public Speaking (OHP)
- Self assessment
- Peer assessment (Accepting)
- Peer assessment (Giving)
- Chairing
- Peer learning
- Team Problem Solving
- Problem Based Team Learning
- Self and Group assessment
- Web research

A Matrix overview of the module

Targeted "social skills"

Real World Problem solving
Meetings Participation
Public Speaking (OHP)
Self assessment
Peer assessment (Accepting)
Peer assessment (Giving)
Chairing
Peer Learning
Team Problem Solving
Problem Based Team Learning
Self and Group assessment
Web research

Targeted "linguistic skills"

Vocabulary (population flow)
Listening (gleaning)
Speaking (public)
Reading (scanning)

Targeted "linguistic functions"

Describing Trends
Public Speaking Signposts
Meetings
Offering Opinions

Procedure A: Public Speaking

Task Described
Preparation
Presentation
Self and Group Assessment
Self Assessment with Video
Feedback Session

Procedure B: Meetings

Meeting Objective Stated
Preliminary Meeting
Monitor Feedback
Main Meeting
Self and Group assessment
Feedback Session

Resources

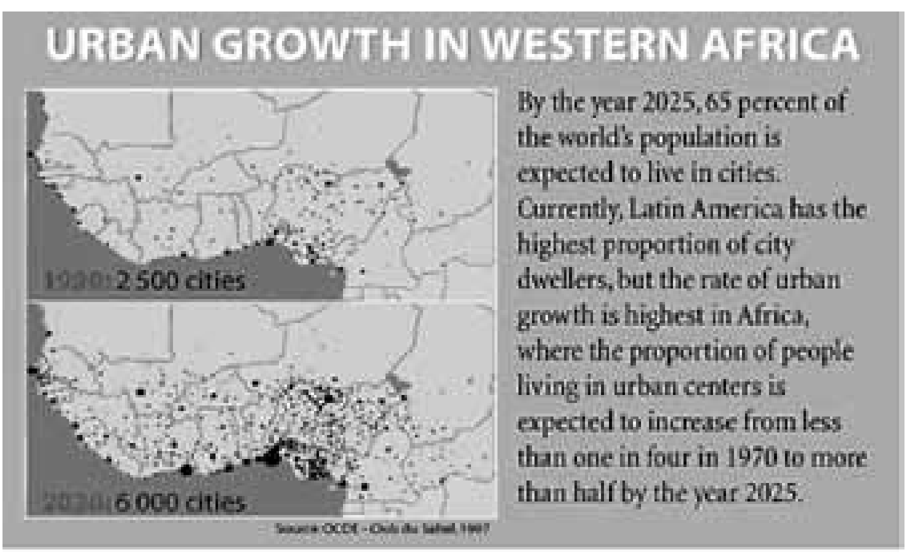
United Nations Web Page
OECD Web Page

Role-play

Problem Based Learning
Student Centred Learning

Procedure A: Public Speaking

- Step 1 The following transparencies are distributed to students in groups of 3 with the simple instruction to look at the information.



- Step 2 Students are told that they will be expected to present the information on the transparencies to the class.
- Step 3 Students are advised to organise their ideas by using T.I.P.S. i.e. decide what the Topic to be discussed is, the Importance of the topic, the Possibilities for dealing with the topic, and finally the Solution. (see annex)
- Step 4 Students in groups divide the work, prepare the presentation with the help of vocabulary lists (see annex) and give the presentation to the group(see annex for presentation framework). The presentations of not more than 15 minutes are filmed and offered for self assessment.
- Step 5 At the end of each presentation an assessment questionnaire is filled in by the audience and given to the speakers.
- Step 6 Speakers are invited to refer to assessment questionnaires when watching their presentations on video.

Procedure B Meetings

- Step 1. Students are given the following instructions:

”*The Governments of Western Africa have realised the dangers of population flow to urban agglomerations. They have called in observers, from various other nations, to join a think tank on the subject. The brief is to come up with short, medium and long term solutions to stem the migration tide into shantytowns which is threatening to suffocate the capitals within the next 50 years*”.

- Step 2. A reminder of the problem is offered:

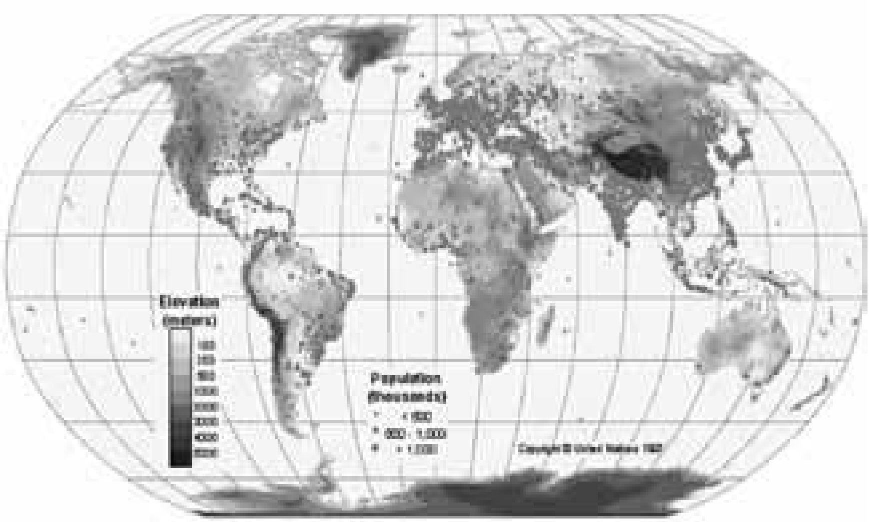
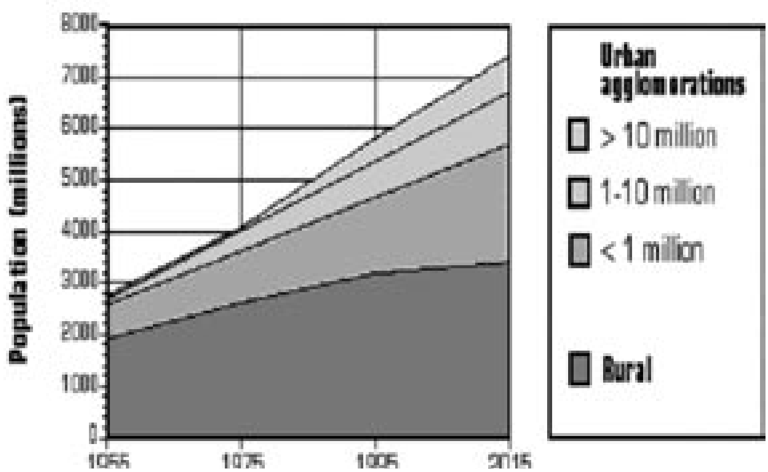


Fig. 16. Urban and rural population, world, 1955-2015



- Step 3. Students are assigned the following cities:
  Group 1 should deal with Mexico.
  Group 2 should deal with Manila.
  Group 3 should deal with Bombay.
  Group 4 should deal with Jakarta.
  Group 5 should deal with Shanghai

and are invited to visit the following web pages which have ample information on how countries are dealing with population flow and urban sprawl.

the United Nations (http://www.un.org)

the OECD (http://www.oecd.org)

- Step 4. Students are invited to use "TIPS" to prepare the meeting. The ***T****opic* being the problem to solve, the ***I****mportance* being for them to decide, the ***P****ossibilities* being what countries are currently doing, and the ***S****olution* being how other countries' solutions could be adapted to Western Africa. (see annex)

- Step 5. Students are presented with words and expressions necessary for running a meeting and are left to find the solutions to the problem posed. (see annex)
- Step 6. Feed-back assessment sheets are distributed and individual and group behaviour is compared, summarised below.

Conclusion

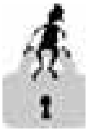
Students find this module to be very motivating as it reflects, to a certain extent, the skills and attitudes, if not the knowledge, necessary to fill the role of an engineer today. Although only a small number will major in urban planning and few of these will have the opportunity to work with NGOs they appreciate the fact of having been posed a problem that they could solve by communicating with others. After an understandable initial reticence at being filmed they learn a lot about how their language and body language suited the task and are much better armed for future opportunities to work in groups and take the floor in public whether in a foreign or native language.

When graduates leave engineering schools they are admitted to the ”School of Hard Knocks” where they learn from their mistakes. The length of time spent in this school depends greatly on whether the student has been able to move from being a dependent learner expecting someone to offer the right answer to an independent learner or an interdependent learner with self assessment skills. The booklets on routes to membership from The Institution of Civil Engineers (UK) make the crucial importance of these matters abundantly clear.

Traditional top down teaching does not wholly correspond to the acquisition of this attitude. There is a rightful place for problem based learning modules in peer groups with the teacher as a monitor and feedback initiator as opposed to the traditional lecturer relying on student shorthand skills to get the message across. Problem based learning modes correspond to real life skills which more closely match what is expected of present day engineers.

Annexes to this Appendix are given in what follows:

Meetings language cheat sheet



Here are a few useful expressions for taking part in relatively informal meetings which can be added to your other cheat sheets.

I would like to begin by.....	Notes
What's your position on.........?	
It seems to me that.....	
I'll give the floor to	
A number of questions seem to have arisen concerning........	
I agree 100%.	
Turning to the next point.............	
The next point on the agenda....	
One thing at a time, please.	
I think you're right, up to a point.	
I'll have to get back to you on that one.	
Who has serious ball park figures?	
I think you could be out of line there.	
I suggest that...	
Have you taken.............. into account?	
What's on your mind?	
Could you go over that again?	
What are you getting at?	
How come?	
Lets recap shall we?	
I'll go for that.	
Shall we go for a vote?	
Who wants to second that?	
Can this be backed up?	
It's not so cut and dry.	
That strikes me as being....	
Let's call it a day.	
Let's wind things up here.	
We can work this out right mow.	
We may going O.T.T. (over the top).	
What do you think number-wise?	
We've got to get things together time-wise.	
Why don't we wrap this up first?	
A stitch in tome saves nine.	
The sooner the better.	
We can draft a memo on the subject.	
The higher-ups should know that.	

TIPS

A simple way to organise your ideas when you are short on time.

THE TOPIC
The topic to be discussed. Try to find a question to ask. Remember listeners are always interested in solutions to problems.

THE INTEREST
Brainstorm all the possible consequences of the topic. Now rank them from the most important to the least.

THE POSSIBILITIES
Brainstorm all the ways you can think of to solve the problem or deal with the topic.

THE SUGGESTION
Choose the possibility or package of possibilities you prefer and explain why.

Graphs, Patterns and Trends

Upward movement	**Notes**
to increase	
to rise	
to go up	
to skyrocket	
to jump	
to gain ground	
to peak	
to reach a peak	

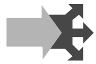
Downward movement	**Notes**
to decrease	
to fall	
to go down	
to slip	
to drop	
to tumble	
to bottom out	
to hit an all-time low	

No movement	**Notes**
to remain steady	
to stay stable	

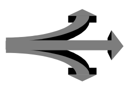
A change of direction	**Notes**
to level off	
to recover	
to fall off	
to fluctuate	

Adverbs	**Notes**
quickly	
obviously / visibly	
definitively	
suddenly	
sharply	
greatly	
definitely	
gradually / slowly	
gently	
considerably	
slightly	

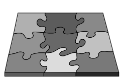
A simple presentation framework

Opening statement 

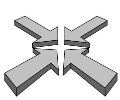
The opening statement lets your audience see you and tune into the way you speak before they begin processing the important information you have to offer them. The audience has to familiarise themselves with the style and accent of the presenter. It is also a good opportunity to show commonality. Try not to use the "I" pronoun. Rather than "*I am going to talk about*......" use something like "*We are going to look at*........". It should be comprised of a few simple active affirmative declarative sentences or S.A.A.D.S. Never begin with an open question to the audience i.e. "*What do you know about* .....?" or "*Have any of you been to* .....?" Do not use complicated words and expressions that give you problems. Keep it simple.
It seems that the best opening statement makes use of the "Interest" in the tips scheme.

Headlines 

Now you should offer a short but general overview showing the main areas that you are going to cover. In this way you limit the subject area and help the audience to organise the information in the way you have. It is a tour map which helps the audience to stay on the right road.
What you could do is show that you are going to identify " the topic", look at ways to solve it ("the possibilities") and give recommendations ("the suggestion").

Body 

Here is the meat on the skeleton of the tour. Any numbers must be visualised, as should difficult concepts and important facts. Use signposts to bridge ideas. Do not be afraid to repeat important information. You can smile! The audience will be grateful if you carefully select what they see and hear.
So in the body you develop the *"topic"*, explain the *"possibilities"* and defend your *"suggestion."*

Recap 

Every presentation should have a summary. It solidifies the information for the audience. Contrary to the tour the summary is specific. You should highlight this with a visual aid.

Closing statement

Prepare the closing statement way in advance. Rock groups keep their best number for the end. This is what the audience is going to remember you personally for. It can explain the next step in the investigation and usually leads to the question and answer period.

To loop the loop you could underline some of what you said in the opening statement.

Signpost Cheat Sheet

Introduction.	**Notes**
Let's begin by......	
Let us start by...... I'll start by...	
It should be mentioned briefly that...	
It seems worth noting that....	
The main issue is obviously....	
A difficult question arises.	

Changing direction.	**Notes**
Right we have looked at... now let me turn to...	
So much for... now turning to....	
Let's move on to....	
Now we can look at / examine...	
Where does that take us?	
Now it is time to discuss....	

Adding.	**Notes**
I might add that..	
I also wish to add that...	
Not only (+ inversion) ...but also....	
Besides / Furthermore / Moreover...	

Giving an example.	**Notes**
To illustrate this point let us consider..	
A case in point is..	
For example / instance...	

Summarising.	**Notes**
Let's recap..	
I'd like to sum up now.....	
Let's remind ourselves of the main points...	

Miscellaneous	**Notes**
This brings us to the question of whether...or....	
We are confronted with...	
One of the most striking features is...	
Before going any further I'd like to remark that...	
I want to point out that.....	
What we are concerned with here is....	
What concerns us here is / It must be borne in mind that......	
I'd like to underline/ stress/ highlight the fact that...	
This detail underlines the importance of...	
It may be asserted that...	
It could be objected that ... however	

Feedback

Forms are given to the students who are required to complete them under the following headings:

PRESENTATIONS:
Opening Statement.
Headlines.
Body.
Recap.
Closing Statement.

OVERALL:
My contribution.
Others' contributions.
Meeting Results

PART FOUR

REPORT OF THE **WORKING GROUP F**

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

Synthesis of Activities Undertaken by the Working Group F

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

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SYNTHESIS OF ACTIVITIES UNDERTAKEN BY THE WORKING GROUP F

1. The scope, role and tasks of Working Group F

The Civil Engineering profession, including Industry and Academe, is facing major challenges and changes. In recognition of this, EUCEET established a Working Group F (WGF) to study the new demands, requirements and needs of the European Civil Engineering Industry, in order that universities would be in a better position to understand these issues and respond to them, in terms of course development and general preparation of students. The Group began its work in May 2000, at the EUCEET Second General Assembly in Odense by considering preliminary ideas on the question of the relationship between the university sector and the industry/professions. This followed on from Working Group C, which had summarised the views of academics on the range, nature and value of links between Academe and Industry. WGF set itself the task of seeking the views of industrial and professional organisations. At the outset it drew up the following aims and objectives:

- To understand better the needs of the Construction/Civil Engineering industry in terms of its needs for trained/educated personnel, skills, attributes and numbers required etc.

- To respond to these where appropriate, whilst not losing sight of the educational role of a university.

- To assist Industry in understanding what the university sector can and cannot do for it.

- To build partnerships, so that Industry and universities see themselves as collaborators in the profession, making complementary contributions to the development of Civil Engineering.

2. Working methods

In tackling its brief, WGF decided to seek opinions from a range of major participants in the Industry/profession concerning their needs and aspirations. Initially, we chose to identify specific organisations and conduct a series of interviews with them, based on a structured questionnaire. The intention was to focus discussion on the key topics in a way that would allow organisations to give opinions and express attitudes rather than simply present basic facts, and it was understood that this would require a different approach in terms of summarising and presenting results.

Each member of WGF set out to identify the following organisations:

- the major national bodies representing employers and the profession at large (eg Federations of Contractors and Consultants, Chamber of Engineers etc);
- three or four of the leading influential organisations, including companies and local authorities/public bodies; and
- any pan-European organisations based in his/her country.

An individual within the organisation was then identified and sent a copy of a questionnaire, to serve as a basis for interview/discussion. The aim was to choose authoritative figures such as Training Officers, Personnel Directors, Managing Directors, Engineering colleagues, etc., able to comment as individuals, to give their organisation's views, and to give what they consider to be the view of the profession as a whole. Where it would prove helpful, national representatives agreed to translate the questionnaire before distribution, though all responses submitted to the secretariat were in English.

In some countries, other organisations of influence whose opinions were considered relevant, such as alumnus groups of the leading universities, were also consulted. In addition, the WG F attempted to take into account the views of SMEs, either as individual companies, or via their representative Federations, or by looking at existing studies that set out their views.

In planning its work programme, WGF was mindful that its active membership did not include representatives from as many countries as it would have wished, and that certain countries were notable by their absence. In these cases the Chairman made contact with relevant national organisations to seek the views required. To a very large extent, this problem was also tackled by collaborating with the Education Task Force of ECCE, the European Council of Civil Engineers, with whom WGF worked very closely.

3. Meetings of the Working Group

As shows, the starting meeting of the Working Group F took place on 20th May 2000 in Odense, Denmark.

Core members of the WH F met on 18th July 2000 in Prague and discussed the draft of the questionnaire to be sent to companies and professional bodies.

The questionnaire was finalised shortly after the Prague meeting and circulated among EUCEET and ECCE members.

The third meeting of the Working Group F took place in London, on 27th October 2000, hosted by the Institution of Civil Engineers.

In addition to the member of the EUCEET WG F the meeting was attended by members of the ECCE Education Task Force.

The fourth meeting of the Working Group F took place in Paris, on 1st March 2001, organised and hosted by E.N.P.C. Paris.

The fifth meeting of the Working Group F took place in Porto, on 11-12 May 2001, organised and hosted by the University of Porto. The meeting was again a joint one with the ECCE Education Task Force.

The sixth and last meeting of the Working Group F took place on 13-16 December 2001 at City University London, when core members of the WG established the final version of the Report.

4. Membership of Working Group F

Chairman: **M. François Gerard Baron,** European Council of Civil Engineers.

Secretary: **Mr. Colin J. Kerr**, Imperial College London, United Kingdom.

Members: **Professor Laurie Boswell**, City University, United Kingdom.
Professor Virgil Breabăn, University "Ovidius" of Constantza, Romania.
Professor Florin Dabija, Technical University of Civil Engineering Bucharest, Romania.
Ms. Yveta Linhartova, University of Pardubice, Czech Republic.
Professor Antal Lovas, Budapest University of Technology and Economics, Hungary.
Professor Alois Materna, Brno University of Technology, Czech Republic.
Dr. Bruce Misstear , Trinity College Dublin, Ireland.
Dipl-Ing. Ralf Reinecke, Technische Universität München, Germany.
Professor Peter Ruge, Technische Universität Dresden, Germany.
Professor Pedro Seco e Pinto, LNEC, Portugal.
Professor Hynek Sertler, University of Pardubice, Czech Republic.
Dr. Vincentas Stragys, Vilnius Gediminas Technical University, Lithuania.
Ms. Gabriela Vila Anton, Valencia University, Spain.

The Working Group's contacts with ECCE were facilitated via the Chairman, François Gerard Baron, Former President of ECCE, and Ms. Diana Maxwell, of the ECCE Secretariat.

DEMANDS OF THE ECONOMIC AND PROFESSIONAL ENVIRONMENTS IN EUROPE WITH RESPECT TO CIVIL ENGINEERING EDUCATION

1. Overview of new demands and requirements: new education, new skills and new competencies

1.1 Civil engineering a profession for the future

Civil Engineering is one of the oldest professions in the world, and Civil Engineering education has been a fundamental part of the curriculum of many of the ancient European universities, often since their earliest days. In common with architecture, students have long regarded Civil Engineering as a very attractive and prestigious profession. However, as with many professions, it has faced dramatic changes in the last two decades, including the following:

- the spectacular economic crisis of the sector at the beginning of the 1990s;
- a reduction of the need for fundamental infrastructure in developed world, and a switch towards repair, maintenance and replacement;
- the transfer of many public works and projects to the private sector;
- restructuring of the Industry and the introduction of new participants;
- development of needs in utilities management;
- the need for civil engineering projects to promote the principles of sustainable development and environmental protection.

These trends have introduced important changes in the availability and aspirations of Engineers and in the requirements of the Civil Engineering sector, as indicated below.

1.1.1 Economic trends

The construction sector is becoming more and more dependent on a country's overall economic situation. This is most obvious in the housing and office building, where demand is very sensitive to the economic environment faced by families as well as business. Within this context, the sector has had to make rapid adjustments in staffing levels in common with, but perhaps even more than, other sectors of Industry. The strong campaign developed ten years ago by contractors, particularly in France for example, to persuade the public authorities to reinvest in large projects to reverse rises in unemployment has, at the same time, created doubts in the minds of students and potential students about the long term futures they might have in the profession.

1.1.2 Reduction in needs

At the same time, the reduction in population growth, together with the large post-war effort undertaken by western countries to develop public infrastructure have, in more recent times, led to a decrease in the need for major infrastructure projects. Current needs are also different in kind, with a greater recognition, in the UK for example, of issues such as repair and maintenance and a switch in housing needs away from the traditional family house. It is significant to note that in response to this, the largest engineering and contracting groups have found replacements in large projects in developing countries, and many have directed their efforts towards other sectors, especially utilities such as water and waste management, energy and telecommunications.

1.1.3 Transfer from the public to the private sector

One of the strongest trends of the past decade has certainly been the transfer of the investment and ownership from the public to the private sector, whatever the political situation of countries.

The development of systems such “concessions” in France, or “design-build-operate” in the UK has deeply affected the profession. The conditions of tendering in such projects are totally new. At the same time this change has resulted in a dramatic transfer of Civil Engineers from ministries or public authorities to the private sector. As a result of this, large firms have had to reinforce their financial and managerial capacities while small and medium sized companies have had to change their marketing and professional practices.

1.1.4 Restructuring and new participants

Civil Engineering remains the leading industrial sector/profession in Europe, in terms of turnover (10 % of the GDP) and employment (12 %). Within the 15 countries of the European Union alone, it comprises more than 2 million companies, of which 95 % employ less than 10 workers. At the other extreme, the largest groups employ more than 50,000 people.

The last decade has seen important mergers. Due to their strong involvement in international business and public facilities, two French groups have become the first and second leading sector companies in the world (VINCI and BOUYGUES). These groups are also (in reverse order) the two world leaders in road construction. Within five regions of France (Departements), VINCI is also the leading organisation in parking and highways management, earning considerable profits from these activities.

It is to be noted that national policies have encouraged the development of worldwide competencies. As a result, VIVENDI and SUEZ have become the two world leaders in water and wastewater management, partly as a result of selling off all their construction activities to VINCI.

These trends have had significant consequences in the world of Civil Engineers. Many of them have been obliged to change their status from Civil Servant to Private Engineer and have also had to update their knowledge in environmental, financial and managerial issues

Mergers, growth and a move into new areas and activities are some examples of change. On the other hand, due to a lack of diversification and to other international developments, the German construction industry has faced major difficulties, which have led to the collapse of the former leading company, Philip Holzmann.

1.1.5 Developments in utilities management

Urban development entails large needs in energy, transport, water/wastewater management and waste treatment. Many of these requirements are relatively new and many have come about as a result of EU Directives. They all require very large financial investment. As in the case of the construction, Governments and local authorities have delegated much of this activity to private sector investors.

1.1.6 Sustainability and environmental protection

These two topics have risen to considerable prominence in recent years, and rightly so. There is no doubt that much legislation at European and national level, for example the EU EIA Directive (1985, amended 1997), has tended to result in longer lead times for projects and much greater project complexity. These topics also require today's Civil and Environmental Engineers to have far more interaction with non-engineering specialists and with the general public. Not only does this require a broader understanding of environmental, legal and other issues on the part of the Civil Engineer, but also the ability to interact in a positive way with a much broader range of people, technical and non technical. This obviously has implication for the training of Civil Engineers, and for the type of personal qualities they must be able to demonstrate.

1.2 A new programme for civil engineers

After two centuries of relative stability and slow change, the nature of the Civil Engineer now sought by Industry to undertake the tasks required by society at large has recently shown remarkable changes. The profile of the Civil Engineer sought by Industry must now include:

- ability and willingness to work in teams;
- managerial qualities;
- knowledge of financial topics and cost management;
- knowledge of environmental issues;

- knowledge of risk and quality management;
- aptitude in the use of new technologies;
- skills in communication and legal issues;

The requirement for technical knowledge in hard sciences has not, of course, disappeared, and is still central to those involved in research institutes and consulting organisations. However, for many Engineers the attributes listed above are required in addition to technical competencies.

1.2.1 Team working

New procedures used in design and execution require large teams of experts. This is true in most aspects of construction, and perhaps particularly true in some of the fast changing and developing sectors such as utilities management, transport and traffic systems and the like. The Civil Engineer no longer depends on his/her technical knowledge alone, but must be prepared to be integrated in groups alongside professionals from many other disciplines such as health and safety, environment, new technologies, accountancy etc. In many cases she/he will be one expert among others.

1.2.2 Managerial qualities

Within all the disciplines mentioned above, the Civil Engineer very often takes the role of manager, which implies acceptance of this type of responsibility. He/she must know all the techniques in project management, be trained to be the leader of a team and have the aptitude to take quick decisions and face new situations.

1.2.3 Financial and economic skills

The transfer of the financial aspects from public to private sector creates new obligations for the project manager. Indeed, nowadays the contractor must not only take on the traditional risks of performing the construction within a tender price but must often develop an artefact or system which has long term financial viability for the contractor-as-operator. Examples such as the channel tunnel prove that technically remarkable and successful projects often have huge financial implications. The Civil Engineer must be competent to appraise the impact of the operation and the maintenance requirements of the built project.

1.2.4 Environmental issues

Environment is probably one of the most challenging issues that a Civil Engineer has to face. Indeed, there are growing demands and expectations from the public concerning environmental issues, and the Civil Engineer is seen as a major protagonist.

However, the profession is regarded as responsible for environmental problems relating to land use, damage to landscape and pollution. At the same time, the Civil Engineer is expected to play a major role in the use of environmental techniques and materials, the reduction of energy consumption, the preparation of environmental impact statements and the real implementation of sustainable development. Obviously, the Civil Engineer cannot be expected possess all the skills and techniques encompassing the environmental state-of-the-art, since this will include many other scientific disciplines. However, today's Civil Engineer must know enough about them to be able to integrate them into the project or process.

1.2.5 Risk and quality management

The Civil Engineer's responsibilities will cover a number of areas, such as health and safety, dangers to the public, environmental damages and financial loss. A new European Directive, currently in preparation, will introduce personal liability for environmental impacts, something which is likely to affect Civil Engineers more than any other engineering discipline.

More and more projects are developed under the ISO norms and the Civil Engineer must become fully familiar with quality management. Construction is probably one of the most difficult sectors in which to implement these requirements, if only because most projects involve such a wide range of participants, including architects, consultants, technical experts, contractors, sub contractors, materials manufacturers and dealers, etc

1.2.6 Aptitude in the use of new technologies

More than many industrial sectors, construction has the potential to benefit from the use of new technologies, with each stage of the construction process becoming increasingly reliant on, and able to benefit from, increased heavy use of them. For example, the design process can involve many different technical experts, such as architects, structural engineers, geotechnical engineers, planners, etc, based in different locations. Reports, designs and other documents need to be exchanged quickly and efficiently between project managers, site staff and design offices, usually against a tight deadline. Information technology has improved this information flow, but there is much scope for further development. New technologies also bring substantial improvements in tendering, supply and management of materials and in continuing education. It is surely the case that Civil Engineers now find that these tools have become permanent and increasingly important.

1.2.7 Skills in communication and legal issues

Traditionally, Engineers have been most comfortable dealing with fellow Engineers rather than members of other professions, perhaps because of their common language of mathematics, in which so many engineering ideas are easily conveyed. Recent developments have changed all this. The public as well as the media have increased expectations of scientific specialists and are increasingly likely to question their work. Many projects have been subjected to public and media scrutiny, for example construction of new nuclear plants, and accidents such as the fire in the Mont Blanc tunnel have undermined public confidence as well as resulted in changes of use of the tunnel by large lorries.

Most projects have now to face a public inquiry in which the Civil Engineer has to demonstrate much more that the technical side of his/her case. Yet it is well known that Engineers have difficulties in communicating with the media and are not necessarily very good at presenting their work to the public. It is increasingly important that the Engineer, as project manager or team leader, must have the ability to present a convincing and confident face to the public and the media as well as communicate with and persuade other technical specialists.

The complexity of many projects, new tendering practices and the development of design-build-operate businesses, as well as the increase of site disputes, suggests that the Civil Engineer also needs to be familiar with the legal aspects of the contracts which link his firm to owners and suppliers. In addition, the engineer must have the capacity to participate to the final writing of the contract as well as the negotiations, in case of a dispute during the completion of the work.

1.3 A new direction for the civil engineer

In many European countries and also in the USA, it is well known that students are less attracted to Engineering professions, preferring instead a whole range of other disciplines, such as business administration. Even amongst those still interested in and involved with science and technology, Civil Engineering seems to lose out compared to others areas such as computing, electronics, telecommunications and so on. In addition, many top Engineers choose to move to other sectors of the economy, such as banking or business administration.

Civil Engineering also has to face other drawbacks, such as non-competitive salaries, onerous travelling commitments and the physical demands of working on site. The exotic aspects of jobs abroad are no longer as attractive as in the past; the large increase in families with two working parents makes the absence of one on long term placements difficult for family life. Finally, it must be said that the sector is also perceived as traditional and not very innovative.

The Industry certainly faces a large task to reverse the present situation, in order to attract the best students and keep good people in the profession. In doing this, the following factors should be stressed:

- although they may offer better salaries at beginning, other sectors are not without their own problems, particularly for mid career staff;
- despite perceptions, the Civil Engineering profession has introduced new practices just as innovative and attractive as others sectors;
- new projects often lead to new challenges, making the profession an exciting and constantly changing one in which to work;
- working on emergency relief and other development projects in low income countries can be a very rewarding experience for Civil Engineers;
- on the other hand, mobility, in terms of long periods away from home, is not essential to be successful in the profession.

2. Topics for discussion with companies and representatives of the profession

2.1 The questionnaire

1. *What sort of staff does your organisation look for when it recruits engineers, technicians, tradespeople? How do you use engineers within your organisation - only as engineers, or as managers, tradespeople, etc?*

2. *Roughly how many staff in each category do you recruit each year?*

3. *In general, are you able to find the sort of staff you want, in the sort of numbers you require?*

4. *If not, what type of problems do you face, e.g., lack of suitably qualified people, difficulty in paying competitive salaries, lack of glamour/popularity of the profession etc?*

5. *When looking for engineers, what level of education do you look for e.g., vocational qualifications, first degree, Masters, PhD, MBA? Can you find enough staff? What is your attitude to qualifications or formations from other countries i.e., what is your attitude towards the mobility of engineers in Europe?*

6. *What sort of technical competences do you look for e.g., structures, geotechnics, mechanics, surveying, environmental engineering etc? Do you look for knowledge of underpinning sciences such as physics, chemistry, materials science, geology, etc? Can you find what you need? If not, what is missing?*

7. *Which transferable skills e.g., IT, communication skills, organisation and presentation skills, numeracy etc, do you look for? Can you find them? If not, what is missing?*

8. *Which personal qualities e.g., flexibility, problem solving, team working ability, initiative etc, do you look for? Can you find them? If not, what is missing?*

9. *Can you estimate the relative importance of technical skills, transferable skills and personal qualities to your company?*

10. *What is your perception of the role of the university in the education/training of civil engineers? At one extreme, this might be to produce trained people who can work for you from day one, at the other, it might be to produce a broadly educated engineering scientist who has little technical knowledge of how to mix concrete, but a deep fundamental understanding of scientific principles. Where do you consider that the balance should lie? Is your organisation aware of the curriculum of a typical university in your country?*

11. *Do you think the university sector produces what you want? If not, hat additional material do you think the universities should teach? What are the gaps between the typical curriculum and what you need in practice?*

12. *Does your company have a clear view of what it wants, or are the construction sector and the job market so flexible and changeable that you cannot be too specific much beyond the mid term?*

13. *Do you have influence over the formation of engineers in your country, as a company or via professional organisations? What sort of influence do you have and how effective is it? If not, would you like to have influence? Can you say briefly what opinions you would offer?*

14. *What is the role/importance of training within your own organisation?Do you expect to have to train people yourself? How does the training you provide compare to what is done in universities? Do you hire from other companies when you lack expertise? What is your attitude towards providing vacation work for students?*

15. *Do you consider it important for your own staff to spend time being involved with the education of engineers in universities e.g., by giving special lectures, advising on curriculum development, providing opportunities for students to get work experience etc. Who does this within your company and what is the extent of the commitment?*

16. *How do you form your links with universities e.g., via personal contact, reputation of the university, content and usefulness of the curriculum etc? At what level do the links exist e.g., scientific/technical staff, Managing Director, training officer, personnel department etc.*

17. *What is your opinion of the nature of existing links between industry, the profession and universities? On the assumption that we do not live in a perfect world, links can no doubt be improved. How?*

18. *How is the licence to practice as an engineer granted in your country? (Perhaps this information is best provided by the interviewer, not the interviewee. Short, outline information only, not a detailed analysis of the accreditation process.)*

19. *Is there anything you wish to add?*

2.2 Analysis of responses

In compiling responses WGF decided to ask national respondents to summarise the answers to the above 19 questions under 6 headings, these being:

- *Is Industry able to find the type of staff it needs in the numbers it requires?*

- *If not, what are the problems and difficulties, for example, lack of certain skills or knowledge in graduates, lack of practical experience, uncompetitive salaries, etc?*

- *What is Industry's view of the output of graduates from the university sector in terms of types of graduate, range of skills, range of technical competence, strengths, weaknesses, etc?*

- *What influence does Industry actually have on the education and training of engineers in universities? What influence would Industry like to have?*

- *What importance does in-house training of Engineers (i.e., training based in the company) have, compared to education and training of Engineers in the university sector?*

- *What opinion does Industry have of the nature of its existing links with Universities?*

Respondents were also asked to submit basic factual details of the position of the Civil Engineering/Construction industry in their country, and to provide a bibliography of reports and studies relevant to the topic.

In the event, it became clear as results were submitted that some countries preferred to ask organisations to fill in questionnaires rather than conduct interviews. Some countries submitted the raw data in the 19 questions but did not supply a 6-point summary; in these cases, summaries were drafted by the WGF secretariat. Needless to say, not all respondents answered all questions, and in some cases replies were somewhat confusing and incomplete, with the resultant need for the secretariat to undertake a certain amount of interpretation of results. In addition, not all countries were able to provide details of their national industry, nor relevant bibliographical information, though this may have been because such information is not available.

2.3 Details of material received

Members of the Working Group and members of the ECCE Task Force on Education provided considerable material, details of which are given below. Some countries did not provide everything. Some countries did not submit the raw data of the questionnaire, relying instead on the six-point summary to cover this. In other cases, questionnaires but not summaries were provided, and in these cases, the WGF secretariat produced their own working summary. A large number of countries were not able to provide bibliographic or industrial data in the form provided. In the case of the industrial data, we have chosen to collect this in a different way, using a template, to make information comparable across the contributing countries.

BELGIUM	Questionnaire
CYPRUS	Questionnaire Description of the national industry
CZECH REPUBLIC	Questionnaire Six point summary Description of the national industry Bibliography
ESTONIA	Questionnaire Six point summary Description of the national industry
FINLAND	Description of the national industry
FRANCE	Questionnaire Six point summary Description of the national industry
GERMANY	Questionnaire: two separate replies

HUNGARY	Questionnaire Six point summary Description of the national industry Bibliography
IRELAND	Six-point summary Description of the national industry
ITALY	Questionnaire
LITHUANIA	Questionnaire Six point summary Description of the national industry
POLAND	Questionnaire
PORTUGAL	Questionnaire Six point summary Description of the national industry Bibliography
ROMANIA	Questionnaire: two responses Six point summary Description of the national industry
SPAIN	Questionnaire: two responses Six point summary
UNITED KINGDOM	Questionnaire Six point summary Description of the national industry

3. Summaries

In considering the responses, many common themes and opinions emerged. This report tries to summarise the situation. Thus, it is written in a way that attempts to provide all-encompassing general answers to the questions posed in the 6-point summary (above), though reference to specific countries is made where this is appropriate. Information about national industries and bibliographies is given on a country-by-country basis.

3.1 Is industry able to find the type of staff it needs, in the numbers it requires?

Most of the fifteen countries in the survey have companies that seek to recruit a wide range of Engineers with a broad range of capabilities stretching from technical competences to personal and transferable qualities skills such as abilities in management, communications, IT etc.

Of those that provided responses, the general opinion was that most countries found they could usually recruit the type and numbers of Engineers needed. Most countries felt there was a reasonable pool of well-qualified Engineers at graduate level.

Although this seems to present a reasonably positive picture, it is also the case that there are problems in a significant minority of cases, some of which are country-specific. For example, in the UK, local and public authorities, which constitute a significant proportion of the employment sector, experience considerably more problems in filling vacancies than do consultants and contractors. In Ireland, although there is no reported problem in finding graduates to take starting positions, there is more difficulty in recruiting both experienced mid-career engineers and enough experienced technicians with the right skills. In Hungary and the Czech Republic, for example, there are shortages in specific areas such as highways, traffic, structural, and water engineering, and in Germany, although the current situation seems reasonable, problems are anticipated in the mid-term future particularly in relation to anticipated shortages in the types of skills provided by students of the Fachhochschulen.

There are other specifically national problems that cloud an otherwise manageable situation. Some countries say that although they can find staff, the people they employ are not necessarily an ideal fit. For example, most countries refer to weaknesses in transferable and personal skills (dealt with in detail elsewhere in this report), some (for example Hungary) talk about the lack of foreign language compatibility. Others (for example Italy and the UK) are concerned about the level of IT skills of the people they employ. Several countries (Germany, Italy, Ireland) seek to overcome shortfalls by making efforts to recruit foreign nationals, while others (Czech Republic) are sometimes obliged to recruit only authorised engineers for independent enterprises in Civil Engineering. This is more likely to be the case in large companies rather than small or medium.

To summarise, the majority of companies in the majority of countries surveyed say that they can find the people they need in the numbers they need but this apparently optimistic pictures hides a number of significant difficulties. Not all sectors in a given country are equally strong. There are common deficiencies in some of the staff employed, particularly in ‘soft’ skills.

In some cases there is an increasing dependence on foreign labour or labour which is not qualified in the conventional sense, and several countries are concerned about the supply of potential staff in the mid-term future.

3.2 If not, what are the problems and difficulties?

Most countries admitted that the profession presents a poor image of itself, due in large part to working conditions and poor salaries compared to other professions. It seems that the profession is valued more highly in southern countries; Portugal, for instance, claims higher salaries in Civil Engineering.

The lack of certain skills such as transferable skills has often been highlighted but the shortage varies from one country to another. In a number of countries, the UK for instance, the need appears to be for the development of skills in communication, IT, finance and management, though the issue of environmental awareness was also raised. Italy and the Czech Republic also stress the importance of training more Engineers with good IT skills. The problem in relation to IT is that Civil Engineering is in strong competition with other engineering professions to recruit good people. In central Europe, there is a definite shortage of engineers with new skills such as financial management, commercial competencies and communication practice, and a shortage of Engineers with good foreign language skills.

Many countries, including Portugal, Romania and Lithuania, stressed the difficulty they have in finding Engineers with practical experience. This situation seems somewhat contradictory, because is also seems to be the case that Senior Engineers sometimes find themselves unemployed and unable to find employment.

In some countries, such as Germany, the education system seems too technical and specialised for what Industry says it needs.

Poor competence in presentation and communication have been identified by several countries including the UK, Ireland and France. Demand for these skills is particularly strong at a time when public pressure on projects is high. These skills are not considered so important in southern and central Europe.

3.3 What is industry's view of the output of graduates from the university sector, in terms of type, range of skills, etc?

Most respondents agreed that universities provide a good broad-based education relevant to Industry, though the situation in Germany is such that Civil Engineering education is sometimes considered too specific and specialised. There is general acceptance that transferable skills are essential and that excessive specialisation was not helpful in this respect.

The survey has established that in addition to the specific knowledge of the main Civil Engineering subject matter, the development of personal qualities is also seen as very important. These personal qualities include team working and communication skills. It was considered essential that in addition to the teaching of technical skills, universities should also provide formal training in transferable skills. There was some implied criticism that universities were not providing this tuition. Some responses to the survey made reference to IT skills. Universities have been innovators in this respect and graduates have usually acquired the appropriate skills needed for use in Industry.

Specific reference was made to an absence of personal tuition in the areas of management, health and safety, economics and a commercial appreciation of the engineering environment.

There was concern, particularly from Germany, that Senior Engineers did not always appreciate the culture of continuing professional development. Although this is not the main role of universities, it would seem natural that they should make provision for continuing professional development.

The two-tier system in Germany enables the Fachhochschulen to provide an education which is more closely related to the needs of Industry than that provided by German universities. The general conclusion was that Industry was satisfied with the quality of educational provision but that more emphasis should be placed on acquiring transferable skills.

3.4 What influence does industry actually have on the education and training of engineers in universities? What influence would it like to have?

Responses to this topic reflected the range and variety of countries surveyed, and also depended upon the historic developments of each country's education system. In Italy, the most important factor influencing what is taught is the law, whilst in the UK, France and Ireland the Professional bodies directly, and Industry indirectly, have a strong influence upon university courses. The former Eastern European countries and Spain considered that there was some, but not much, influence whilst Cyprus reported no influence at all. Germany also reported no influence either from industry or the profession. It was unanimously agreed however, that positive external influence, and indeed involvement, was desirable.

The professional accreditation procedure in the UK and Ireland ensures that industry influences university courses. This is also the case in Hungary and Spain, but to a lesser extent. In Germany, because of the lack of influence by Industry and the Professions, German universities are not able to respond easily to the changes in Industry.

The influence of Industry may be felt in two ways. Firstly, through the accreditation of courses by visiting professional panels and secondly by direct involvement in teaching and research. All respondents reported some involvement through teaching and research. Details of these latter activities can be found in the report of Working Group C, Volume I of the EUCEET Report Series.

There was some comment that universities should try to have a better understanding of the needs of Industry and that this might be a suitable catalyst for involvement with Industry.

3.5 What importance does in-house training have compared to education and training in the university sector?

Not surprisingly, nearly all countries surveyed stressed the importance of in-house training and made it very clear that the training they provided was significantly different from what they expected the university sector to provide. Universities were expected to deal with the provision of fundamental scientific and technical material and to encourage the development of personal qualities and transferable skills in their students. Industry expected to provide training in skills and tasks of specific interest to them, particularly management, safety, communication, business, specialised IT etc. It is noteworthy that many of these items are considered to be absent from many university curricula. Indeed, universities would admit that they are not in the best position to provide all of this anyway.

However, despite making positive statements on the merits of in-house training, there are difficulties and not all countries have well developed systems. For example, Germany and Lithuania, while recognising the importance of in-house training, have not yet developed good systems. Several other countries (France, Czech Republic, UK) have patchy coverage. Some larger companies and consulting firms in these countries tend to have well developed programmes, whereas small and medium sized companies find it very difficult to devote resources to this, even though they recognise its importance.

Although the emphasis seems to be on company staff providing training, based on company needs and experience, there is a growing tendency in some countries eg Portugal, for the development of programmes based on collaboration with universities.

3.6 What opinion does industry have on the nature of its existing links with universities?

Links with universities is clearly a topical issue within Industry and the situation varies greatly according to the structure of the profession in each country.

In some countries such as France, the main links with universities are secured through professional bodies. Within the UK and Ireland, the links are operated by the Institution of Civil Engineers and the Institution of Engineers of Ireland respectively, which aim to be aware of the needs of the profession.

In some countries such as Germany and Italy the links are weaker and their development is considered essential by Industry. In Central Europe, Industry is slowly becoming organised and as such, links have, until now, generally depended on personal contacts. In some cases such as the Czech Republic and Romania, co-operation between universities and Industry has been set up as a signed formal agreement.

Most of the countries have underlined the need for improved links. Though it seems that the profession is well informed regarding study programmes and curricula, Industry often find that its needs are not always taken into account.

Many countries are encouraging strong links between universities and Industry particularly in the field of continuing education. It seems that life-long learning may offer good opportunities to academics to update their knowledge of Industry, while at the same time giving engineers working in Industry opportunities to develop and enhance their flexibility and extend their range of skills, something which is becoming increasingly important.

There is a general view, stressed by countries such as Romania and the Czech Republic for example, that there should be increased contacts between Industry and universities.

4. The scope of national industries

Of the fifteen countries which were surveyed, eight provided information about their home Industry. However, the responses were very varied in style and content, which made it difficult to draw conclusions and comparisons. In retrospect, it would have been better to have asked participants to present their information in a unified format, making it easier to compare data from different countries. To tackle this, the Working Group prepared a template asking for specific information and is in the process of collecting data. At the time of writing (May 2002), this information is still being collected, and so far, we have responses in the required format from the following countries: Czech Republic, Germany, Hungary, Ireland, Portugal, Romania.

5. Bibliography

It has proved difficult to collect details of national studies, reports, and other documents relevant to this topic. Some details have been provided, and these are listed below. However, it is evident that coverage is patchy.

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6. Conclusions

This report shows that, in general terms, Industry is able to find a satisfactory number of suitably trained personnel, though within this apparently optimistic picture, there are localised problems such as the lack of certain specialist technical skills and recruitment difficulties faced by public authorities compared to the private sector. Where these occur, they tend to be country-specific.

Although the scientific background of graduates generally meets Industry’s requirements, improvements are still needed in human sciences, transferable skills and personal qualities. There is clearly a strong requirement for a broader spread of knowledge, skills and personal aptitudes.

The profession still needs a research force and research investment. It is remarkable, and worrying, to note that the sector, which represents 10 % of GDP of the European Union, only invests 1 % of its turnover in research and development, while the USA spends 2 % and Japan 2.5 %.

Demographic impacts on the structure of the Industry should also be noted. Many of the managers of the 2 million companies operating within the European Union at the moment will retire during the next twenty years. There is a strong need for companies to be active in succession planning for senior management. This will require Civil Engineers to develop their competencies so that they can address the increasingly diverse problems and challenges, both technical and non-technical, which face our profession.

PART FIVE

EUCEET REGIONAL FORA
IN THE DISSEMINATION YEAR

First EUCEET Regional Forum

Jose-Luis JUAN-ARACIL
Escuela Técnica Superior de Ingenieros de Caminos,
Canales y Puertos, Madrid (ES)

Second EUCEET Regional Forum

Stanislaw MAJEWSKI
Silesian University of Technology, Gliwice (PL)

Third EUCEET Regional Forum

Dipl.-Ing. Ralf Reinecke
Technische Universität München (DE)

THE FIRST EUCEET REGIONAL FORUM

MADRID, SPAIN, 9th - 10th MAY 2002

As agreed by the Steering Committee in its meeting, held in Paris, on 10th November 2001, the first EUCEET Forum of 2002 took place in Madrid, Spain on 9-10 May. The host on this occasion was the Madrid Polytechnic University's Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos (Higher Technical School of Civil Engineers).

The Forum was one of the first acts organised as part of the Escuela's 200th anniversary celebrations - as a direct descendant of the Ecole National des Ponts et Chaussées, it is one of Europe's oldest engineering schools.

The formal opening of the Forum took place on Thursday 9 May and was chaired by the Honourable Rector of the Madrid Polytechnic University and President of the Spanish Confederation of University Rectors, Professor Saturnino de la Plaza, who welcomed over one hundred participants, 41 of whom came from 19 European countries. Among the Spanish participants were representatives from Spain's nine Civil Engineer Schools and three technical civil engineering schools, as well as a good number of engineers coming from construction companies and the Spanish Ministry for Infrastructure (Fomento).

The Rector shared the Presidency with the President of the Civil Engineers' College, Professor Juan Miguel Villar Mir, the Director of the Road Enginers' College, Professor Edelmiro Rua and Professor Iacint Manoliu, Secretary General of EUCEET Steering Committee.

Immediately following the opening session, Professor and Civil Engineer, Antonio Lopez Corral gave a paper on "*Training of the public sector Civil Engineer*". Professor Lopez Corral, currently Director General for Economic Planning at Fomento, emphasised in his paper the need for state-employed civil engineers to modernise the government approach by including in their training a focus on the new systems of infrastructure financing, capital flows and management models, all of which enhance innovation in the private sector. To this end, he made a number of specific proposals: economics and management modules in the graduate or post-graduate syllabus; joint seminars on infrastructure concession models with private sector engineers and academic experts; government-university agreements for analysis and design and improved infrastructure management and financing practices.

He went on to detail the government's 192,000 million Euro Infrastructure Programme for the period 2000-02, with particular emphasis on private sector participation in the financing of Spain's future large infrastructure projects and the subsequent need for well-trained engineers to ensure their success.

After an animated discussion and a refreshment break another Civil Engineer, Joaquin Ayuso - Director General and Executive Officer at Ferrovial-Agroman, Spain's largest construction company - gave the second presentation: "*The engineer and the European construction company*." Mr Ayuso began with a series of statistics on Ferrovial-Agroman group's activities which showed it at the forefront of European construction and in some areas, such as infrastructure concession, via its filial company CINTRA, the largest in the world. Mr Ayuso repeated that his aim was to give an overview of what, in his view, European construction groups looked for when selecting engineers. In particular, he went on, they looked for an all-round training which included, inter alia, management and leadership techniques and group handling skills. To this end, the engineer requires a series of personal qualities which not all graduates. Mr. Ayuso underlined that Ferrovial-Agroman pay great attention to employee selection and in-house training.

The subsequent discussion following Mr. Ayuso's talk rounded off the first day of the EUCEET Forum.

The programme continued on Friday 10 May with a talk by another Engineer, Mr. Juan Luis Lopez Cardenete, Director General for Networks from Union Fenosa, Spain's second-largest hydroelectric generator, intitled "*The engineer and the energy industry*".

Mr. Lopez Cardente underlined how important it was, in his view, that those who taught engineering should themselves be practising engineers and thus "teach from experience". He also spoke of the importance of a more general, humanist education to enable the engineer to be an effective force more widely and not just in his or her area of technical expertise.

It was also important to encourage student mobility - including language learning, study trips and work experience within companies - and engineers emotional intelligence, as many would be required to make important decisions at decisive moments which would affect the lives of a great many people.

After a general discussion and a lively coffee-break, the participants joined in a roundtable with most of the nine Directors from Spain's civil engineering schools and chaired by the Director of the Madrid Civil Engineering Escuela, Mr. Edelmiro Rua. Following discussion at the regular Directors' meetings in recent months, Mr. Rua gave a detailed presentation of the changes forecast in Spanish civil engineers' training to bring it into line as far as possible with the Bologna Declaration.

The college Directors subsequently intervened, followed by a debate with the floor which brought out the varying opinions on issues such as the importance of investigation in engineers' training or the need for a general approach as opposed to higher degrees of specialisation.

After the roundtable, Professor Manoliu gave a presentation of the EUCEET network, and invited all Civil Engineers´s Spanish teaching establishments and businesses to join. Followed a series of questions on the network from participants.

The Forum continued in the afternoon with the presentation of six working groups, finishing at 19.00.

The Colegio de Ingenieros de Caminos, Canales y Puertos (Spanish National Association of Civil Engineers) hosted dinner at their headquarters.

Prof. Jose-Luis JUAN-ARACIL
Escuela Técnica Superior de Ingenieros de Caminos,
Canales y Puertos, Madrid

Programme of the first EUCEET Regional Forum

Thursday, May 9th	
16:30	***Opening Ceremony***
	Prof. Saturnino de la Plaza Pérez (Rector of the Universidad Politecnica Madrid) – *Welcome address*
17:00	***Session 1***
	Prof. Antonio M. López Corral (Director of Economic Programming, Department of Fomento) – *Education of the Civil Engineer as a Civil Servant*
17:30	***Discussions***
17:45	***Break***
18:00	Joaquin Ayuso (Managing Director of FERROVIAL-AGROMAN) – *The Civil Engineer in the European Building Firm*
18:45	***Discussions***
19:00	***Closing of the session***

Friday, May 10th	
9:30	***Session 2***
	Juan Luis López Cardenete (Managing Director of FENOSA) – *The Civil Engineer in the Energetic Industry*
10:15	***Discussions***
10.30	***Break***
10.45	***Round Table*** with Directors of the Spanish Civil Engineering Schools
12.00	Prof. Iacint Manoliu (Technical University of Civil Engineering Bucharest) *General presentation of EUCEET Thematic Network*
12:30	***Discussions***
13:00	***Closing of the session***
13:30	***Lunch***
15:45	***Session 3***
	Presentations of the Reports of the EUCEET Working Groups A, B and C
17.15	***Break***
17.30	Presentations of the Reports of the EUCEET Working Groups D, E and F
19:00	***Closing of the Forum***

THE SECOND EUCEET REGIONAL FORUM

GLIWICE, POLAND, 13^{th} - 15^{th} JUNE 2002

The 2^{nd} EUCEET Forum took place at the Silesian University of Technology in Gliwice, Poland on 13^{th} to 15^{th} of June 2002. Gliwice is located in the region of Upper Silesia in the southern part of Poland. This strongly urbanised region is the industrial centre of Poland. The city of Gliwice is known due to the simulated attack of German troops posing as Polish troops on the German radio station, which provided a pretext to begin the Second World War in September 1939. The mast of this radio station, probably is one of tallest timber masts in the world, still exists and is preserved as the reminder of these tragic events.

The 2^{nd} EUCEET Forum was organised by Prof. S. Majewski, Dean of the Civil Engineering Faculty. Just before the Forum the annual meeting of deans and vice-deans of Polish CE Faculties took place in Gliwice. The 40 participants of this meeting were invited and many of them took part in the Forum. Also 27 persons from the EUCEET partnership and some staff members of CE Faculty of SUT participated in the Forum.

The Rector of the Silesian University of Technology Professor W. Zielinski opened the Forum. He gave the welcome address as well as a brief presentation of the university, which is one of biggest Technical Universities in Poland. It was established in 1945 and is considered as the successor of famous Lvov Polytechnic, one of the biggest Polish Technical Universities before the Second World War, now in the Ukraine.

Currently more than 32 000 students study at 12 faculties of this University. The academic staff comprises 1755 members including 120 full professors and 125 associated professors. The host of the Forum Professor Majewski, presented the information on the Faculty of Civil Engineering, one of four faculties, which has existed from the very beginning of the SUT.

The Forum programme comprised of 18 presentations, grouped under 3 themes:

1. EUCEET and its activities undertaken during 3 years of the project duration;
2. Educational systems at Civil Engineering faculties in Central & Eastern European countries;
3. Special problems connected with Bologna Process.

In the first group, Prof. Manoliu gave the general information about objectives and activities of EUCEET, which is one of the biggest thematic networks within the SOCRATES programme. He briefly presented subjects of interest to six Working Groups. This was followed by detailed reports about the results of each WG.

Particularly:

- Prof. R. Kowalczyk from the University of Beira Interior in Covilha, Portugal presented the results of WGA, which dealt with "*Curricula in Civil Engineering Education at Undergraduate Level*". The wide-ranging presentation was prepared (together with Prof. T. Bugnariu from Technical University in Bucharest, Romania) with respect of two topics: Organisation of CE Education at Undergraduate Level in Europe and Curricula Structure for the 1st Degree in Europe.
- Prof. Manfred Federau from the Engineering College in Odense, Denmark spoke about "*Quality Assurance and Quality Management in Civil Engineering Educational Institutions*", which was the subject of interest of WGB.
- Colin Kerr from the Imperial College in London, UK presented the outcomes of WGC on "*Synergies between universities, research industry and public authorities in European construction sector*".
- Prof. Iacint Manoliu from the Technical University of Civil Engineering of Bucharest, Romania spoke about the results achieved in WGD, which worked on "*Curricula in Civil Engineering Education at Postgraduate Level*".
- Prof. Leal Lemos from University of Coimbra, Portugal presented the outcomes of WGE dealing with "*Innovation in teaching and learning in civil engineering education*".
- Colin Kerr from the Imperial College in London, UK presented the report prepared together with Prof. Laurie Boswell (City University London) and François Gerard Baron (ECCE) on activities undertaken in WGF "*Demands of the economic and professional environments in Europe in respect to civil engineering education*".

In the second group of presentations the information about the current state of Civil Engineering Education in following European countries was given:

- Czech Republic by Prof. Josef Machacek from Technical University in Prague,
- Estonia by Prof. Laur Thomas from Technical University in Tallin,
- Hungary by Prof. Antal Lovas from Budapest University of Technology and Economics,
- Italy presented by Prof. Giovanni Barla from Technical University Turin,
- Latvia by Prof. Juris Smirnovs from Technical University in Riga,
- Lithuania by Prof. V. Stragys and Prof. P. Vainiunas from Technical University in Vilnius,
- Poland by Prof. Stanislaw Majewski from Silesian University of Technology in Gliwice,
- Slovakia by Prof. Josef Dicky from Slovak Technical University in Bratislava,
- United Kingdom by Prof. David Lloyd Smith from Imperial College in London.

In the third thematic group two very interesting presentations were given:

- Prof. Carsten Ahrens from University of Applied Sciences in Oldenburg, Germany spoke about "*Modularising European Civil Engineering Curricula*". Modularised curricula seem to be the sine qua non precondition of problem oriented education. Basing on his experience, as well as on the Manual of good practice entitled "*Modularising Engineering Education Curricula*" elaborated in Oldenburg the speaker presented detailed recommendation how to switch from traditional to modular study curriculum.
- Prof. Guenther Heitmann from Technical University in Berlin spoke about the Implementation and Accreditation of Bachelor/Master Degree Courses in Germany. The German experience is of particular interest as the educational system in this country significantly differs from the recommendations of Bologna Declaration, which created the background for "European Space for Higher Education". On the other side, some problems such as poor level of internationalisation, high average duration of studies and low level of success rates are observed and suggest the need of changes in organisation of the educational process. Conditions for these changes were defined in the revised Framework Act for Higher Education from August 1998, which permits Bachelor and Master degrees both at Universities and Fachhochschulen, limits the duration of studies and requires the modularisation of curricula, credit points and accreditation of programmes. According to German Accreditation Council, Bachelor courses should last 3-4 years and Master programs 1-2 years. The total duration of Bachelor/Master programme should not be longer than 5 years.

All presentations are available on the Internet on the page katinz.bud.polsl.gliwice.pl/euceet/

Prof. Stanislaw MAJEWSKI
Silesian University of Technology, Gliwice

Programme of the second EUCEET Regional Forum

Thursday, June 13th	
16:30	***Opening Ceremony***
	Prof. Stanislaw Majewski (SUT Gliwice) Chair of the Organising Committee *Welcome address*
	Prof. Wojciech Zielinski (SUT Gliwice) Rector of SUT - *Welcome address*
17:00	***Session 1***
	Prof. Marie-Ange Cammarota (ENPC Paris), Prof. Iacint Manoliu (TUCE Bucharest) - *General presentation of the EUCEET Thematic Network*
	Prof. Guenther Heitmann (TU Berlin) - *The Implementation and Accreditation of Bachelor/Master Degree Courses in Germany*
19.00	***Welcome Reception.*** *Exposition of CE Faculty student's elaborations carried out within the Semestral Practical and Integrated Project System*
Friday, May 10th	
9:00	***Session 2*** - *Reports of the EUCEET Working Groups A, D and B*
	• Prof. Ryszard Kowalczyk (University of Beira Interior, Covilha) - *Report of Working Group A* • Prof. Iacint Manoliu (TUCE Bucharest) - *Report of Working Group D* • Prof. Manfred Federau (Engineering College, Odense) - *Report of Working Group B*
10:20	***Break***
10:40	***Session 3 -*** *Reports of the EUCEET Working Groups E, C and F*
	• Prof. Leal Lemos (University of Coimbra) - *Report of Working Group E* • Colin Kerr (Imperial College, London) - *Report of Working Group C* • Prof. Colin Kerr (Imperial College, London) - *Report of Working Group F*
12:00	***Break***
12:20	***Session 4***
	Prof. Carsten Ahrens (University of Applied Sciences, Oldenburg) - *Lecture on Modularising European Civil Engineering Curricula*
	Prof. David Lloyd Smith (Imperial College, London) - *Civil Engineering Education in UK*
	Prof. Giovanni Barla (Politecnico di Torino) - *Civil Engineering Education in Italy*
14:15	***Lunch***
15:45	***Session 5***
	Prof. Josef Machacek (TU Prague), Prof. Alois Materna (TU Ostrava) - *Civil Engineering Education in Czech Republic*
	Prof. Josef Dicky (Slovak TU Bratislava) - *Civil Engineering Education in Slovak Republic*
	Prof. Antal Lovas (TU Budapest) - *Civil Engineering Education in Hungary*

	Prof. Vincentas Stragys (TU Vilnius) - *Civil Engineering Education in Lithuania*
	Prof. Toomas Laur (TU Tallin) - *Civil Engineering Education in Estonia*
	Prof. Juris Smirnovs (TU Riga) - *Civil Engineering Education in Latvia*
	Prof. Stanislaw Majewski (Silesian TU, Gliwice) - *Civil Engineering Education in Poland*
18:00	***Closing of the Forum***

THE THIRD EUCEET REGIONAL FORUM

MUNICH, GERMANY, 6th –7th SEPTEMBER 2002

The *Fakultät für Bauingenieur - und Vermessungswesen* (Department of Civil and Survey Engineering) of the *Technische Universität München (TUM)* was proud to host the third EUCEET Forum 2002. Along with the dissemination of results achieved by six EUCEET working groups, the aim was to balance the efforts of those collective European groups by a local or regional perspective.

On Thursday, September the 5th, one day before the actual Forum, the EUCEET Steering Committee met at the *Lehrstuhl für Massivbau* (Chair of Concrete Structures). At the meeting Prof. Cammarota was able to announce the acceptance of the EUCEET II proposal by the European Commission, which ensured a continuation of the project beyond the dissemination fora.

The formal opening of the 3rd EUCEET Forum was held on Friday, September the 6th 2002. Prof. Rackwitz and, as a representative for the president of the *Technische Universität München*, Prof. Cmiel welcomed over fifty participants from 14 different European countries.

This was followed by an introduction of the EUCEET project by Prof. Manoliu from the *TUCE Bucharest* and the first session with a presentation of Prof. Bugnariu from the *TUCE Bucharest* on the undergraduate curriculum throughout Europe. Prof. Kreuzinger gave the opportunity to compare the results with the situation at the *Technische Universität München* with his paper: "*Civil Engineering Education at the TUM*". He explained the current and the future wide range of engineering education at the Department of Civil and Survey Engineering. While the *TUM* is providing the opportunity to offer several Master degrees within Civil Engineering, the university will also remain to offer the degree of a "*Diplomingenieur*" as an option for a broader level of education.

In the second session, Prof. Salgado de Barros from *Ordem dos Engenheiros* informed about an accreditation model for engineering courses and quality management in civil engineering education. As the president of the *FTBV* (a congregation of delegates of all faculties with civil engineering and/or geodetic/ geoinformatics engineering universities of all German speaking countries) Prof. Schweizerhof from the *University of Karlsruhe* was able to present the state of the art discussion on the implementation of the Master/Bachelor system in German speaking countries and the current models of accreditation. The opposing views led to an interesting discussion among the participants, which made it obvious that practised accreditation models are difficult to adapt since the systems of education differ on a wide range within European countries. Especially in Germany complications evolve with the introduction the Master/Bachelor system as it disables a necessary distinction between the accreditation of *Universitäten* (universities) and *Fachhochschulen* (polytechnic schools).

Colin Kerr from the *Imperial College London* illustrated the results on synergies between research, industry and public authorities in a third session before the lunch break. The participants took the opportunity during the break to visit one of Munich's famous beer-gardens close to the university campus.

In the following fourth session, Prof. Manoliu gave an outline of the state of the art postgraduate and continuing professional development in civil engineering and Dr. Scholz's paper managed to complete the topic by the example of a local postgraduate academy for continuing professional education in Bavaria.

Innovation in teaching and learning in civil engineering education was the topic of the fifth session. Prof. Holmes from the *Imperial College London* worked out the differences between the application of modern information technology in teaching and the need of teaching methods beyond one-to-many-lectures. As a case study for information technology tools to teaching, Mr. Romberg from the *Technische Universität München* reported about the current conversion of the German *Betonkalender* into an interactive multi-media design guide which will be made available on the internet. Currently several of its interactive applications are used for teaching in the civil engineering department at the *Technische Universität München*.

In the sixth and last session of the 3rd EUCEET forum, the focus was on the actual demands of the professional environments on civil engineering education. The former president of ECCE, Mr. Baron, explained that, although the EUCEET working group was assisted by members of ECCE, the demands of the professional environment was hard to tackle for a group consisting mainly of academics. Mr. Ritzer the president of the German ECCE and especially Dr. Blaschko from the construction company *Bilfinger und Berger AG* (with 41.000 employees worldwide) managed to give the participants a useful insight on the needed skills of university graduates. Dr. Blaschko made it clear that both, generalist and specialist were essential for the industry. Management, process planning, law and economics are playing an increasing role while basic fields such as mathematics and surveying are viewed as less important. He finished his presentation with the demand of the industry towards the universities: "Studies at universities should not last too long to leave enough time for further training in the construction firm". At the end of an interesting discussion Prof. Rackwitz thanked the speakers and closed the forum sessions.

In the evening Prof. Zilch welcomed the EUCEET forum participants at a traditional Bavarian dinner which was set up in the laboratory of Concrete, Steel and Wood Structures. This made it possible for interested participants to get a small tour through some experimental set-ups before the buffet was opened. At the end of the evening, Prof. Manoliu thanked Prof. Zilch and Mr. Reinecke for hosting the forum.

On the next day two separate excursions were offered: A city tour through the older parts of Munich and a small pilgrimage to the nearby beer brewing monastery which was built in 1455. It was a sunny and warm day and, after a hike up to the hill, the tour through the monastery was concluded by the taste of Benedictine brewed beer.

Dipl.-Ing. Ralf Reinecke
Technische Universität München

Programme of the third EUCEET Regional Forum

Friday, September 6th	
09:00	***Opening Ceremony***
	Dr. Edmund Cmiel (TU Munich) - *Introduction of the TU Munich*
	Prof. Iacint Manoliu (TUCE Bucharest) - *General Presentation of EUCEET*
09:20	***Session 1***
	Dr. Tudor Bugnariu (TUCE Bucharest) - *Curricula in Civil Engineering Education at Undergraduate Level*
	Prof. Heinrich Kreuzinger (TU Munich) - *Civil Engineering at the TU Munich*
10:00	***Session 2***
	Prof Antonio S. de Barros (Ordem dos Engenheiros, Portugal) - *Accreditation Model for Engineering Courses and Quality Management in Civil Engineering Education*
	Prof. Dr.-Ing. Karl Schweizerhof (Vorsitzender des FTBV) - *Implementation of Bachelor/Master in Germany*
10:40	***Break***
11:10	***Session 3***
	Colin Kerr (Imperial College London) - *Synergies between Universities, Industry and Public Authorities in the Construction Sector of Europe*
11:50	***Lunch***
13:30	***Session 4***
	Prof. Iacint Manoliu (TUCE Bucharest) - *Postgraduate education and Continuing Professional Development in Civil Engineering*
	Dr. Ulrich Scholz (Ing. Akademie Bayern) - *Continuing Education – German Situation*
14:10	***Session 5***
	Prof. Patrick Holmes (Imperial College London) - *Innovation in Teaching and Learning in Civil Engineering Education*
	Dipl.-Ing. Richard Romberg (TU Munich) - *IT Tool to Teaching*
14:50	***Break***
15:20	***Session 6***
	François Gerard Baron (former President of ECCE) - *Demands of the Economic and Professional Environments in respect to Civil Engineering Education*
	Stefan Ritzer (President of German ECCE) - *From a Consultant's point of View*
	Dr. Michael Blaschko (Bilfinger Berger AG) - *View of a Construction Contractor*
16:30	***Closing of the Forum***