INQUIRIES INTO EUROPEAN HIGHER EDUCATION IN CIVIL ENGINEERING

LIFELONG LEARNING - ERASMUS
THEMATIC NETWORK PROJECT

EUROPEAN CIVIL ENGINEERING EDUCATION AND TRAINING

EIGHTH EUCEET VOLUME

Edited by
Iacint Manoliu

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FOREWORD

This is the eighth of a series of volumes to be published within 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 Lifelong Learning programme.

The volume opens with an Overview of activities undertaken within EUCEET III project between 1 October 2006 and 31 March 2010.

The volume comprises the Reports of the Working Groups pertaining to five, out of the total of eight, themes undertaken under EUCEET III project:

- Theme C: "*Doctoral programmes – 3rd cycle – and research in civil engineering faculties*" (Chairperson of the Working Group: Associated Professor Marina Pantazidou, National Technical University of Athens, Greece).
- Theme E: "*Implementation of the framework for qualifications in civil engineering based on learning outcomes and competences*" (Chairman of the Working Group: Professor Laurie Boswell, City University London, UK).
- Theme F: "*Approaches to teaching and learning, assessment and performance in civil engineering education*" (Chairman of the Working Group: Dr. Ralf Reinecke, IB Reinecke Munich, Germany).
- Theme G: "*Making the European civil engineering education better known and more attractive outside Europe*" (Chairman of the Working Group: Professor Carsten Ahrens, University of Applied Sciences Oldenburg, Germany).
- Theme H: "*Developing a synergy between academic and professional worlds*" (Chairman of the Working Group: Colin Kerr, Imperial College London, UK)

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

Thanks are due to dipl.eng. Mia Trifu and eng. Doina Irodel for the help provided to the editor.

Professor Iacint MANOLIU

Chairman of EUCEET III
Management Committee

ABOUT THE EDITOR

Iacint MANOLIU is Professor of Geotechnical Engineering at the Technical University of Civil Engineering in Bucharest. He spent one year (1968) as a Fulbright scholar at the University of Texas at Austin. Served as Vice-Dean of the Faculty of Civil, Industrial & Agricultural Buildings between 1972 – 1976 and as Dean of the same Faculty between 1976 – 1984. Between 1990 and 2000 was Vice-Rector for Academic and International Affairs of the TUCEB. Presently is President of the Council for Cooperation and Relations of the University. Was Secretary General of the Steering Committee of the Thematic Network Project EUCEET I and Chairman of the Management Committee for Projects EUCEET II and EUCEET III. Following the 1st General Assembly of the EUCEET Association (Warsaw, 24 October 2008), was designated as General Secretary of the Association.

Prof. Iacint MANOLIU is President of the Romanian Geotechnical Society, Vice-President of the Union of Associations of Civil Engineers of Romania and Chairman of the Standing Committee on Education & Training of ECCE (European Council of Civil Engineers).

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(1 October 2006 – 31 March 2010) -

an overview

EUCEET III (1 October 2006 – 1 March 2010) - AN OVERVIEW

Marie-Ange CAMMAROTA[1], Iacint MANOLIU[2]

On 24th August 2006, Ecole Nationale des Ponts et Chaussées, as Applicant, was notified by the European Commission that the application for a new Project EUCEET III was approved for a 3-year duration, starting on 1st October 2006. Eventually, the Financial Agreement number 230355-CP-1-2006-1-FR-ERASMUS-TN was concluded between Ecole Nationale des Ponts et Chaussées, as Contractor, and the European Commission. A 3-month extension of the project was granted in June 2009 and then another 3-month extension of the project granted in November 2009. EUCEET III ends on 31st March 2010.

This paper is aimed to overview activities undertaken under EUCEET III for the whole duration - 42 months - of the project. Information will be essentially limited to the meetings of the Management Committee and to the General Assemblies, since reference to the meetings of the Working Groups are being made in the reports presented by the WGs and included in the volumes 7 and 8 of EUCEET.

In the Annex of the paper is shown the attendance of the three EUCEET III General Assemblies: Santander (15-16 March 2007), Warsaw (23-24 October 2008) and Paris (19-20 November 2009).

1. EUCEET III in the first year (2006 - 2007)

In the table 1 is given a chronology of the meetings which took place in the first year of EUCEET III (1 October 2006 - 30 September 2007).

Table 1

EUCEET meetings in the 1st year	
Data venue	**Purpose**
8 December 2006, Vilnius	1st meeting of the EUCEET III Management Committee
14 March 2007, Santander	2nd meeting of the EUCEET III Management Committee
15-16 March 2007, Santander	**1st EUCEET III General Assembly**
15-16 March 2007, Santander	meeting of the Working Group for Theme A
15-16 March 2007, Santander	meeting of the Working Group for Theme E
15-16 March 2007, Santander	meeting of the Working Group for Theme F
15-16 March 2007, Santander	meeting of the Working Group for Theme G

[1] Coordinator of EUCEET III project, Professor, Ecole Nationale des Ponts et Chaussées, Paris, France,
[2] Chairman of EUCEET III Management Committee, Professor , Technical University of Civil Engineering, Bucharest, Romania

EUCEET meetings in the 1st year	
Data venue	**Purpose**
15-16 March 2007, Santander	meeting of the Working Group for Theme H
16 March 2007, Santander	Workshop under the Theme A
4 – 5 May 2007, Brussels	Techno TN 2007 Forum
28 September 2007, Madrid	3rd meeting of the EUCEET III Management Committee

- *The 1st meeting of the EUCEET III Management Committee, Vilnius, 8 December 2006*

The meeting was organized and hosted by the Vilnius Gediminas Technical University and was attended by the following members: Prof. Marie-Ange Cammarota, ENPC Paris, EUCEET III Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Jean Berlamont, Katholieke Universiteit Leuven; Prof. Jozef Machacek, AECEF; Prof. Carsten Ahrens, Fachhochschule Oldenburg DE; Ralf Reinecke, IB Reinecke; Prof. Marina Pantazidou, National Technical University Athens; Prof. Pericles Latinopoulos, Aristotle University Thessaloniki; Luis Garrote, Escuela Caminos Madrid; Prof. Benjamin Suarez, Escuela Caminos Barcelona; Prof. Richard KASTNER, INSA Lyon; Prof. Diego Lo Presti, Universite de Pisa; Prof. Juris Smirnovs, Technical University of Riga; Prof. Antal Lovas, Budapest University of Technology & Economics; Prof. Gyorgy Farkas Budapest University of Technology & Economics; Prof. Stanislaw Majewski, Silesian Technical University; Prof. Nicoleta Radulescu, Technical University of Civil Engineering Bucharest; Prof. Laurie Boswell, City University London; Prof. David Lloyd Smith and Colin Kerr, Imperial College London; Prof. Eivind Bratteland, Norwegian University of Science and Technology Trondheim.

The main results of the meeting, as put into evidence by the minutes, were:

- presentation of the provisions of the contract for the 1st year of EUCEET III
- establishing EUCEET III general framework
- defining the involvement of various categories of partners (higher education institutions, research centers, professional associations, companies) in the activities related to various Themes
- deciding on the coordination of the 8 Themes
- deciding on the chairpersons of working groups for the 8 Themes
- preliminary discussions on the 5 Themes to start in the 1st year
- tentative programme of the 1st General Assembly to be held in Santander on 15 – 16 March 2007
- logistic matters related to the General Assembly in Santander.

- *The 2nd meeting of the Management Committee, Santander, 14 March 2007*

The meeting took place before of the 1st General Assembly of EUCEET III and was attended by the following members: Prof. Marie-Ange Cammarota, Ecole Nationale des Ponts Paris Tech, EUCEET III Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Jean Berlamont, Katholieke Universiteit Leuven; Prof. Jozef Machacek, AECEF; Prof. Carsten Ahrens, Fachhochschule Oldenburg DE; Ralf Reinecke, IB Reinecke; Prof. Marina Pantazidou, National Technical University Athens; Prof. Pericles Latinopoulos, Aristotle University Thessaloniki; Luis Garrote, Escuela Caminos Madrid; Prof. Franco Branco, Technical University Lisbon; Prof. Benjamin Suarez, Escuela Caminos Barcelona; Prof. Richard KASTNER, INSA Lyon; Prof. Diego Lo Presti, Universite de Pisa; Prof. Antal Lovas, Budapest University of Technology & Economics; Prof. Gyorgy Farkas Budapest University of Technology & Economics; Prof. Nicoleta Radulescu, Technical University of Civil Engineering Bucharest; Prof. Jan Bujnak, University of Zilina; Prof. David Lloyd Smith and Colin Kerr, Imperial College London;

The main points on the agenda were:

- Information on the meeting at the EC with the coordinators of TNPs, Brussels 22nd January 2007
- Information on the organization of the General Assembly (measures taken by the host university, registered participants, etc.)
- Presentation by Chairpersons of the Terms of reference for Themes A, E, F, G, H and of the WGs
- Decision on the chairpersons for Working Groups in charge with the Themes B, C, D
- Designation of EUCEET representatives to participate at the 2007 Techno Forum, Brussels, 4 – 5 May 2007

- *1st EUCEET III General Assembly, Santander, 15 – 16 March 2007*

The 1st EUCEET III General Assembly was organized and hosted by the University of Cantabria in Santander. In the opening session, welcome addresses were presented by Excmo. Sr. D. Federico Gutiérrez-Solana Salcedo, Rector Magnífico de la Universidad de Cantabria, Ilmo. Sr. D. Iñigo de la Serna Hernáiz, Concejal de Medio Ambiente y Aguas del Ayuntamiento de Santander and Ilmo. Sr. D. José Antonio Revilla Cortezón, Director de la Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos de la Universidad de Cantabria.

The General Assembly was attended by representatives of the following institutions partners in EUCEET III: Ecole National des Ponts Paris Tech, Katholieke Universiteit Leuven, Université. Catholique Louvain, Université de

Liège, Czech Technical University in Prague, Association of European Civil Engineering Faculties, University of Pardubice, Brno University of Technology, Technical University of Ostrava, Technical University of Denmark, Aalborg Universitet, Technical University Munchen, IB Reinecke GMBH, Technical University Darmstadt, Fachhoschule Oldenburg, Technical University Dresden, National Technical University of Athens, TEI Piraeus, Aristotle University of Thessaloniki, University of Patras, Universidad Politecnica de Madrid, Colegio de Ingenieros de Caminos, Canales y Puertos, Universidade da Corũna, Universidad de Cantabria, Universidad de Castilla la Mancha, Universitat Politecnica de Catalunya, Tallinn University of Technology, Conseil National des Ingenieurs et Scientifiques de France, Institut National des Sciences Appliquees de Lyon, Ecole Nationale des Travaux Publics de l' Etat, Ecole Spéciale des Travaux Publics, du Bâtiment et de l'Industrie, Institut Supérieur du Béton Arme Marseille, University of Dublin Trinity College, University College of Dublin, Politecnico di Milano, Università di Roma Tor Vergata, Università di Trento, Università di Firenze, Università di Pisa, Cyprus Association of Civil Engneers, Technical University of Riga, Latvian Association of Civil Engineers, Lithuanian Association of Civil Engineers, Vilnius Gediminas Technical University, University of Malta, Budapest University of Technology and Economics, Hungarian Chamber of Engineers, Janus Pannonius University, Delft University of Technology, Graz University of Technology, Wroclaw University of Technology, Warsaw University of Technology, Rzeszow University of Technology, Road & Bridge Research Institute, Byalistok Technical University, Silesian Technical University, Universidade do Porto, Universidade do Minho, University Beira Interior, High Technical Institute of Lisbon, Ordem dos Engenheiros, Laboratorio Nacional de Engenharia Civil – LNEC, University of Maribor, University of Ljubljana, Slovak University of Technology Bratislava, University of Zilina, Helsinki University of Technology, Finnish Association of Civil Engineers RIL, European Council Civil Engineers, Chalmers University of Technology, Loughborough University, City University of London, Imperial College, Cardiff University, Heriot-Watt University, Norwegian University of Science and Technology Trondheim, University of Architecture, Civil Engineering and Geodesie, "Gh. Asachi" Technical University of Iasi, Ovidius University of Constantza, Polytechnic University of Timisoara, Technical University of Cluj-Napoca, Technical University of Civil Engineering Bucharest, Union of Association of Civil Engineers of Romania, Procema RO, Middle East Technical University, Turkish Chamber of Civil Engineers, Istanbul University.

In the first plenary session of the General Assembly, following the opening session, Prof. Marie-Ange Cammarota and Prof. Iacint Manoliu made a presentation of the project.

The TNP EUCEET III develops, like TNPs EUCEET I and EUCEET II, *themes* recognised by the partners to be of major significance for European Civil Engineering Education. The 8 themes proposed for EUCEET III are:

A. Implementation of the two-tier study programmes in civil engineering education across Europe, following the Bologna process
B. Enhancement of the cooperation between civil engineering faculties in Europe by the development of joint degrees
C. Doctoral programmes – 3rd cycle – and research in civil engineering faculties
D. Best practice in establishing and running multi-disciplinary programmes of education, involving civil engineering and other fields
E. Implementation of the framework for qualifications in civil engineering based on learning outcomes and competences
F. Approaches to teaching and learning, assessment and performance in civil engineering education
G. Making the European civil engineering education better known and more attractive outside Europe
H. Developing a synergy between academic and professional worlds

According to the decision adopted by the Management Committee in its first meeting in Vilnius, on 8th December 2006, five of eight Themes were to be launched at the General Assembly in Santander:

Table 2

Theme and Chairperson
A. Implementation of the two-tier study programmes in civil engineering education across Europe, following the Bologna process (I. Manoliu, Technical University of Civil Engineering Bucharest, RO)
E. Implementation of the framework for qualifications in civil engineering based on learning outcomes and competences (L. Boswell, City University London, UK)
F. Approaches to teaching and learning, assessment and performance in civil engineering education (R. Reinecke, IB Reinecke Munich, DE)
G. Making the European civil engineering education better known and more attractive outside Europe (C. Ahrens, University of Applied Sciences Odenburg, DE)
H. Developing a synergy between academic and professional worlds (C. Kerr, Imperial College London, UK)

As a consequence, following the first plenary sessions, the General Assembly featured parallel sessions for themes E and G and for A, F and H.

In the second day of the General Assembly, the chairpersons of the Working Groups for the five themes presented the outcomes of the first meeting of the WG for the respective Theme, terms of reference, deliverables expected, plan of activity.

In the programme of the General Assembly was included a Workshop under Theme A "*The new first cycle degree programmes in civil engineering in Europe: problems and solutions*", which took place also on the second day.

The following presentations were made:

Invited lecture: *"Implementing the Bologna Process in Civil Engineering. Towards the European Higher Education Area"* – Federico Gutiérrez-Solana, Excmo. y Magnífico, Rector de la Universidad de Cantabria

State-of-the-art report: "*Civil engineering education in Europe - 2007, 8 years after the Bologna Declaration"* – Prof. Iacint Manoliu

Reports:

- Prof. Jean Fr. Thimus, Université Catholique Louvain, Belgium

- Prof. Vaclav Kuraz, Czech Technical University in Prague, Czech Republic
  "*First experience with the implementation of the 3-tier Bologna System*"

- Prof. Peter Ruge, Technical University Dresden, Germany
  "*BA/MA at German Universities"*

- Prof. Benjamin Suarez, Universitat Politecnica de Catalunya, Spain
  "Bologna Process in Spain"

- Prof. Antal Lovas, Budapest University of Technology and Economics, Hungary
  "*Hungarian Civil Engineering BSc-MSc Program after Joining the EU* "

- Prof. William Magette, University College Dublin, Ireland
  "Implementation of Bologna-style Programmes in Civil Engineering at University College Dublin"

- Prof. Diego Lo Presti, Università di Pisa, Italy
  "*The new first cycle degree programmes in civil engineering in Italy: three examples*"

- Prof. Szczepan Wolinski, Rzeszow Politechnika, Poland
  "*The first cycle degree in civil engineering in Rzeszov University of Technology"*

- Prof. Joao Leal, University of Beira Interior, Covilha, Portugal
  "*The new first cycle degree programme in civil engineering at the University of Beira Interior - a Portuguese case study"*

- Prof. Dan Stematiu & Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Romania
  "*The transition from an integrated to a two-tier study programme at the Technical University of Civil Engineering Bucharest - an iterative process*"

- Prof. Josef Vican & Prof. Jan Bujnak, University of Zilina, Slovakia
  "The new first cycle degree programmes in civil engineering at University of Zilina - problems and solutions"

- Prof. Josef Dicky, Slovak Technical University Bratislava, Slovakia
  "*The new first cycle degree programmes in civil engineering at Slovak University of Technology in Bratislava*"

- Prof. Ian May, Heriot-Watt University, United Kingdom
  "*Implementation of the Bologna Declaration in the UK - a personal view*"

Closing the General Assembly, Prof. Iacint Manoliu wished every success to the newly contributed Working Groups for the five Themes and expressed, on behalf of the Management Committee and of all participants, the warmest thanks to Excmo. Sr. D. Federico Gutiérrez-Solana Salcedo, Rector Magnífico de la Universidad de Cantabria, Ilmo. Sr. D. Iñigo de la Serna Hernáiz, Concejal de Medio Ambiente y Aguas del Ayuntamiento de Santander, Ilmo. Sr. D. José Antonio Revilla Cortezón, Director de la Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos de la Universidad de Cantabria, in particular, to the contact person of ETSICCP for EUCEET III, Prof. Soledad Nogués, for the support provided and for the excellent organisation of the event.

- *The 3rd meeting of the Management Committee, Madrid, 28 September 2007*

The meeting was hosted by Universidad Politecnica de Madrid and was attended by the following members of the Management Committee: Prof. Marie-Ange Cammarota, ENPC Paris, EUCEET II Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Jean Berlamont, Katholieke Universiteit Leuven; Prof. Josef Machacek, Czech Technical University in Prague; Prof. Carsten Ahrens, Fachhoschule Oldenburg; Prof. Ivo Herle, Technical University Dresden, Prof. Luis Garrote, University Polytechnic Madrid, Prof. Benjamin Suarez, University Polytechnic Catalunya; Ms. Soledad Nogues and Ms. Amaya Lobo, Universidad de Cantabria, Prof. Roger Frank, Ecole Nationale des Ponts et Chaussées Paris; Prof. Richard Kastner, Institut National des Sciences Appliquees Lyon ; Prof. Marina Pantazidou, National Technical University Athens; Prof. Pericles Latinopoulos, Aristotle University Thessaloniki; Prof. Antal Lovas, Budapest University of Technology and Economics; Prof. Gyorgy Farkas, Budapest University of Technology and Economics; Prof. Diego Lo

Presti, University of Pisa, Prof. Juris Smirnovs, Technical University of Riga, Prof. Fernando Branco, Technical University Lisbon, Prof. Nicoleta Radulescu, Technical University of Civil Engineering Bucharest; Prof. Jan Bujnak, University of Zilina; Prof. Laurie Boswell, City University, Prof. David Lloyd Smith and Mr. Colin Kerr, Imperial College London; Prof. Feyza Cinicioglu, Istanbul University; Prof. Ilknur Bozbey, Istanbul University.

The main points on the agenda, as put into evidence by the minutes, were:

- Brief reports from the Chairpersons of the Working Groups:
  - A. Implementation of the two-tier study programmes in civil engineering education across Europe, following the Bologna process (Iacint Manoliu)
  - E. Implementation of the framework for qualifications in civil engineering based on learning outcomes and competences (Laurie Boswell)
  - F. Approaches to teaching and learning, assessment and performance in civil engineering education (Ralf Reinecke)
  - G. Making the European civil engineering education better known and more attractive outside Europe (Carsten Ahrens)
  - H. Developing a synergy between academic and professional worlds (Colin Kerr).
- Presentation of the Application for the Project "*EUCEET EXTENSION - extending Thematic Network EUCEET to third countries*" submitted on 31st May 2007 to EC under Action 4 of the Erasmus Mundus programme
- Information on the development related to EUCEET Association since the General Assembly in Santander
- Discussions on the involvement of EUCEET in the 6th AECEF International Symposium (May 28-30, 2008, Vilnius)

Other meetings at which presentations on EUCEET III were made

Presentation on EUCEET objectives and outcomes was made by comprehensive presentations at various meetings:

- The 45th ECCE (European Council of Civil Engineers) meeting, Bucharest, 11 May 2007
- XIVth European Conference on Soil Mechanics and Geotechnical Engineering, Discussion Session 4.1 "Allowable movements of old and modern structures in urban areas", Madrid, 26 September 2007

2. EUCEET III in the second year (2007-2008)

In the table 2 is given a chronology of the meetings which took place in the second year of EUCEET III (1 October 2007 – 30 September 2008).

Table 2.

EUCEET III meetings in the 2nd year	
Date, venue	**Purpose**
4 April 2008, Pisa	4th meeting of the EUCEET III Management Committee
6 May 2008, Prague	Workshop under the Theme G
23 May 2008, Riga	Workshop under the Theme H
2-3 June 2008, Constantza	Workshop under the Theme A
12 June 2008, Brussels	meeting Tuning
22 August 2008, Athens	Workshop under the Theme E
22 October 2008, Warsaw	5th meeting of the EUCEET III Management Committee
23-24 October 2008, Warsaw	**2nd EUCEET III General Assembly**
23-24 October 2008, Warsaw	meeting of the Working Group for Theme A
23-24 October 2008, Warsaw	meeting of the Working Group for Theme E
23-24 October 2008, Warsaw	meeting of the Working Group for Theme F
23-24 October 2008, Warsaw	meeting of the Working Group for Theme G
23-24 October 2008, Warsaw	meeting of the Working Group for Theme H
23 October 2008, Warsaw	Workshop under the Theme F
24 October 2008, Warsaw	meeting of the Working Group for Theme C
24 October 2008, Warsaw	meeting of the Working Group for Theme B
24 October 2008, Warsaw	meeting of the Working Group for Theme D

- *4th meeting of the EUCEET III Management Committee, Pisa, 4 April 2008*

The meeting was organised and hosted by the University of Pisa and attended by the following members of the Management Committee: Prof. Marie-Ange Cammarota, ENPC Paris, EUCEET III Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Jean Berlamont, Katholieke Universiteit Leuven; Prof. Josef Machacek, Czech Technical University in Prague; Mr. Ralf Reinecke, IB-Reinecke GMBH; Carsten Ahrens, Fachhoschule Oldenburg; Prof. Luis Garrote, University Polytechnic Madrid; Prof. Benjamin Suarez, University Polytechnic Catalunya; Mrs. Amaya Lobo, Universidad de Cantabria; Prof. Pericles Latinopoulos, Aristotle University Thessaloniki; Prof. Antal Lovas, Budapest University of Technology and Economics; Prof. Diego Lo Presti, University of Pisa; Prof. Juris Smirnovs, Technical University of Riga; Prof. Radu Bancila, University “Politehnica” Timisoara; Prof. Doina Verdes, Technical University of Cluj-Napoca; Prof. Nicoleta Radulescu, Technical University of Civil Engineering Bucharest; Dr. David Lloyd Smith, Imperial College; Mr. Colin Kerr, Imperial College; Prof. Feyza Cinicioglu, Istanbul University; Prof. Eivind Bratteland, Norwegian University of Science and Technology.

The main points on the agenda, as revealed by the minutes, were:

- Information on the audit of the EUCEET II project in the year 2004-2005
- Information on the ERASMUS Coordinators' Meeting 2008 (Brussels, 25-26 February 2008)
- Reports on the activities of the Working Groups for the Themes A, E, F, G, H
- Information on the preparations for the 2nd EUCEET III General Assembly

- *5th meeting of the EUCEET III Management Committee, Warsaw, 22 October 2008*

The meeting was organised and hosted by the Warsaw University of Technology and attended by the following members of the Management Committee: Prof. Marie-Ange Cammarota, ENPC Paris, EUCEET II Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Jean Berlamont, Katholieke Universiteit Leuven; Prof. Josef Machacek, Czech Technical University in Prague; Carsten Ahrens, Fachhoschule Oldenburg; Prof. Luis Garrote, University Polytechnic Madrid; Prof. Benjamin Suarez, University Polytechnic Catalunya; Mrs. Amaya Lobo, Universidad de Cantabria; Prof. Pericles Latinopoulos, Aristotle University Thessaloniki; Prof. Antal Lovas, Budapest University of Technology and Economics; Prof. Diego Lo Presti, University of Pisa; Prof. Juris Smirnovs, Technical University of Riga; Prof. Wojciech Gilewski, Warsaw University of Technology; Dr. David Lloyd Smith, Imperial College; Mr. Colin Kerr, Imperial College; Prof. Feyza Cinicioglu, Istanbul University.

The main points on the agenda, as revealed by the minutes, were:

- Information on the audit of the project undertaken by the representatives of the EC
- Situation of the budget of the project by 15th October 2008
- Proposal for a work plan for the 3rd year of the project
- Brief reports presented by the Chairpersons of the WGs for the themes launched at the 1st GA in Santander: WG A (I. Manoliu), WG E (L. Boswell), WG F (R. Reinecke), WG G (C. Ahrens), WG H (C. Kerr)
- Information on the organization of the 2nd EUCEET III General Assembly in Warsaw

- Discussions on the future activities under the auspices of the EUCEET Association

- *Second EUCEET III General Assembly, Warsaw, 23-24 October 2008*

The Second EUCEET III General Assembly was organised by the Warsaw University of Technology. The following EUCEET III partners were represented at the General Assembly: Katholieke Universiteit Leuven, Cyprus Civil Engineers Association, University of Pardubice, Czech Technical University, Fachhochschule Oldenburg, Technical University Darmstadt, IB-Reinecke, Technical University Munich, Technical University of Denmark Lyngby, Tallin Technical University, Universidad Politecnica de Madrid, Colegio de Ingenieros de Caminas, Canale y Puertas Madrid, University of Cantabria Santander, Helsinki University of Technology, Conseil National des Ingenieurs et des Scientifiques de France, Ecole Nationale des Ponts et Chausses Paris, Institut National des Sciences Appliquees de Lyon, Institut Superieur du Batiment et des Travaux Public Marseille, Ecole Speciale des Travaux Public Paris, Aristotele University of Thessaloniki, University of Patras, Aristotle University of Thessaloniki, Technological Education Institution of Serres, National Technical University Athens, Technological Education Institute of Piraeus, University of Pecs, Budapest University of Technology and Economics, University College Dublin, Trinity College Dublin, University of Trento, University of Pisa, Politecnico di Milano, Vilnius Gediminas Technical University, Riga Technical University, Delft University of Technology of Netherlands, Norwegian University of Science and Technology Trondheim, Wroclaw University of Technology, Warsaw University of Technology, Bialystok Technical University, LNEC Lisbon, Technical University of Lisbon, University of Beira Interior Covilha, University of Porto, "Ovidius" University of Constantza, Technical University of Civil Engineering Bucharest, PROCEMA Bucharest, Technical University "Gh. Asachi" Iasi, Technical University of Cluj-Napoca, University of Maribor, University of Ljubljana, Slovak University of Technology Bratislava, Technical University Ostrava, University of Zilina, Istanbul University, Turkish Chamber of Civil Engineers, Middle East Technical University Ankara, City University London, Imperial College London, Cardiff University, Heriot Watt University Edinburgh.

The venue of the General Assembly was at Warsaw University of Technology, Faculty of Civil Engineering.

In the first plenary session, Philippe Courtier, Director at Ecole Nationale des Ponts Paris Tech presented the lecture: "*Climate change and civil engineering education*".

Then, Prof. Marie-Ange Cammarota, ENPC Paris, EUCEET II Coordinator and Prof. Iacint Manoliu, TUCE Bucharest, Chairman of EUCEET II MC, made a presentation on the Project in the 1st and 2nd year and of the main features of the application for the 3rd year.

The second plenary session hosted two invited lectures:

- Ms. Uma Patel (Centre for Adult Education, City University London): "*Technology, work and education in the 21st century: changing dynamics and new challenges*"
- Prof. Wojciech Gilewski (Warsaw University of Technology): "*To teach or not to teach finite elements*"

The afternoon programme started with parallel sessions for the Themes A and G, followed by parallel sessions for the Themes E and H.

The programme of the first day of the GA ended with a Workshop under the auspices of the Working Group F (chairman: Ralf Reinecke, IB-Reinecke Munich) "*Approaches to teaching and learning, assessment and performance in civil engineering education*".

In the morning plenary sessions of the second day of the GA, the chairpersons of the Working Groups A and E presented the final reports for the Themes A and E followed by the chairpersons of the Working Groups F and G who presented the preliminary reports for the respective themes.

Then it was made the presentation of the Terms of References for the three new Themes to be tackled in the 3rd year of the project: Theme B – "Enhancement of the cooperation between civil engineering faculties in Europe by the development of joint degrees" (chairman: Prof. Radu Bancila, University "Politehnica" Timisoara), Theme C – "Doctoral programmes – 3rd cycle – and research in civil engineering faculties" (chairperson Prof. Marina Pantazidou, National Technical University Athens) and Theme D "Best practice establishing and running multi-disciplinary programmes of education, involving civil engineering and other fields" (chairman Prof. Tudor Bugnariu, Technical University of Civil Engineering Bucharest).

In the afternoon plenary session, there were, in parallel sessions, meetings of the Working Groups for the Themes B, C and D.

The plenary session concluded with the presentations, by the Chairpersons of the WGs B, C and D, of the workplans for the three new themes.

Conclusions of the General Assembly were drawn by Prof. Iacint Manoliu, Chairman of the EUCEET III MC, who expressed sincere thanks to the Warsaw University of Technology and, in particular, to Prof. Wojciech Gilewski to whom the Faculty of Civil Engineering confined the task to support EUCEET in the organisation of the second General Assembly.

Other meetings at which presentations on EUCEET III were made

Presentation on EUCEET objectives and outcomes was made by comprehensive presentations at various meetings:

- The 46th ECCE (European Council of Civil Engineers) meeting, Athens, 19 October 2007;

- Tuning – Georgia Launch Conference, Tbilisi, 3 – 6 March 2008;
- The 47th ECCE (European Council of Civil Engineers) meeting, Riga, 23 May 2008;
- 1st International Conference on Education and Training in Geo-Engineering Sciences, Constantza, 2-3 June 2008.

3. EUCEET III in the third year (2008-2010)

In the table 3 is given a chronology of the meetings which took place in the third year of EUCEET III (1 October 2008 - 31 December 2005).

Table 3

EUCEET III meetings in the 2nd year	
Date, venue	**Purpose**
1 December 2008, Paris	Meeting EACEA
6 February 2009, Barcelona	6th meeting of the EUCEET III Management Committee
26 March 2009, Leuven	Workshop under the Theme C
7 May 2009, Bucharest	Workshop under the Theme F
5 June 2009, Timisoara	Workshop under the Theme B
19 June 2009, Edinburgh	7th meeting of the EUCEET III Management Committee
9 September 2009, Brussels	Meeting EACEA
26 September 2009, Budapest	Workshop under the Theme E
26 October 2009, Zilina	8th meeting of the EUCEET III Management Committee
19-20 November 2009, Paris	**3rd EUCEET III General Assembly**
19-20 November 2009, Paris	meeting of the Working Group for Theme F
19-20 November 2009, Paris	meeting of the Working Group for Theme G
19-20 November 2009, Paris	meeting of the Working Group for Theme H
19-20 November 2009, Paris	meeting of the Working Group for Theme B
19-20 November 2009, Paris	meeting of the Working Group for Theme C
19-20 November 2009, Paris	meeting of the Working Group for Theme D
5 February 2010, Lisbon	9th meeting of the EUCEET III Management Committee

- *6th meeting of the EUCEET II Management Committee, Barcelona, 6 February 2009*

The meeting was organized and hosted by the Universitat Politecnica de Catalunya, Barcelona and was attended by the following members of the EUCEET III Management Committee: Prof. Marie-Ange Cammarota, ENPC Paris, EUCEET III Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Jean Berlamont, Katholieke Universiteit Leuven; Prof. Josef Machacek, Czech Technical University in Prague; Prof. Carsten Ahrens, Fachhoschule Oldenburg; Mr. Ralf Reinecke, IB-Reinecke GMBH; Prof. Luis Garrote, University Polytechnic Madrid, Prof. Benjamin Suarez, University Polytechnic Catalunya; Prof. Xavier Sanchez-Vila, Escola Tècnica Superior d'Enginyers de

Camins, Canals i Ports de Barcelona; Prof. Pedro Serrano, Escola Tècnica Superior i Camins Santander, Prof. Roger Frank, Ecole Nationale des Ponts Paris Tech; Prof. Thibaut Skrzypek, Ecole Nationale des Ponts Paris Tech; Prof. Richard Kastner, Institut National des Sciences Appliquees Lyon; Prof. Marina Pantazidou, National Technical University Athens; Prof. Pericles Latinopoulos, Aristotle University Thessaloniki; Prof. Antal Lovas, Budapest University of Technology and Economics; Prof. Gyorgy Farkas, Budapest University of Technology and Economics; Prof. Diego Lo Presti, University of Pisa, Prof. Juris Smirnovs, Technical University of Riga, Prof. Fernando Branco, Technical University Lisbon, Prof. Wojciech Gilewski, Warsaw University of Technology, Prof. Radu Bancila, University "Politehnica" Timisoara, Prof. Nicoleta Radulescu, Technical University of Civil Engineering Bucharest; Prof. Tudor Bugnariu, Technical University of Civil Engineering Bucharest, Prof. Jan Bujnak, University of Zilina; Prof. Laurie Boswell, City University, Dr. David Lloyd Smith and Mr. Colin Kerr, Imperial College London; Prof. Feyza Cinicioglu, Istanbul University; Prof. Eivind Bratteland, Norwegian University of Science and Technology.

The main points on the agenda, as revealed by the minutes, were:

- Information on the General Assembly in Warsaw
- Information on the communication received from Brussels concerning the audit undertaken in 2008 by the company Moore & Stephens from U.K. on the 3rd year of the project EUCEET II, and discussions on the measures to be taken by partners
- Information on the Field Monitoring Visit undertaken at ENPC by representatives of EACEA (Education, Audiovisual & Culture Executive Agency) on 1st December 2008
- Information on the communication received from Brussels concerning the audit undertaken in 2008 by the company Moore & Stephens from U.K. on the 3rd year of the project EUCEET II, and discussions on the measures to be taken by partners
- Situation of the budget of the project by 1st February 2009
- Reports on the activities of the Working Groups founded in Santander for the themes:

  F: "*Approaches to teaching and learning, assessment and performance in civil engineering education*"
  Chairman: Ralf Reinecke, IB-Reinecke Munich

  G: *"Making the European civil engineering education better known and more attractive outside Europe"*
  Chairman: Carsten Ahrens, FH Oldenburg

  H: "*Developing a synergy between academic and professional worlds*"
  Chairman: Colin Kerr, Imperial College London

- Information on the starting actions of the Working Groups founded in Warsaw for the themes:
  B: *"Enhancement of the cooperation between civil engineering faculties in Europe by the development of joint degrees"*
  Chairman: Radu Bancila, Univ. Politehnica Timisoara
  C: "*Doctoral programmes – 3rd cycle – and research in civil engineering faculties"*
  Chairperson: Marina Pantazidou, NTU Athens
  D: *Best practice in establishing and running multi-disciplinary programmes of education, involving civil engineering and other fields"*
  Chairman: Tudor Bugnariu, TUCE Bucharest
- Establishing the work plan for the period until the 3rd General Assembly in Paris, on 15-16 October 2009.

- *7th meeting of the EUCEET II Management Committee, Edinburgh, 19 June 2009*

The meeting was organized and hosted by the Heriot-Watt University and was attended by the following members of EUCEET III Management Committee: Prof. Marie-Ange Cammarota, ENPC Paris, EUCEET III Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Jean Berlamont, Katholieke Universiteit Leuven; Prof. Josef Machacek, Czech Technical University in Prague; Prof. Carsten Ahrens, Fachhoschule Oldenburg; Mr. Ralf Reinecke, IB-Reinecke GMBH; Prof. Luis Garrote, Technical University of Madrid; Prof. Benjamin Suarez, University Polytechnic Catalunya; Prof. Pierre Michaux, Ecole Nationale des Ponts Paris Tech; Prof. Marina Pantazidou, National Technical University Athens; Prof. Pericles Latinopoulos, Aristotle University Thessaloniki; Prof. Antal Lovas, Budapest University of Technology and Economics; Prof. Gyorgy Farkas, Budapest University of Technology and Economics; Prof. Diego Lo Presti, University of Pisa; Prof. Juris Smirnovs, Technical University of Riga; Prof. Wojciech Gilewski, Warsaw University of Technology; Prof. Radu Bancila, University "Politehnica" Timisoara; Prof. Nicoleta Radulescu, Technical University of Civil Engineering Bucharest; Prof. Jan Bujnak, University of Zilina; Dr. David Lloyd Smith and Mr. Colin Kerr, Imperial College London; Prof. Eivind Bratteland, Norwegian University of Science and Technology.

The main points on the agenda, as revealed by the minutes, were:

- Information on the actions undertaken by the Management Committee in response to the audit by Moore and Stephens and the letter of EACEA
- Information on the demand for prolongation with 3 months (to 31 December 2009) of the EUCEET III Project.

- Situation of the budget by 1st June 2009
- Reports on the outcomes of the Working Groups founded in Santander for the themes:

  F: "*Approaches to teaching and learning, assessment and performance in civil engineering education*" Chairperson: Ralf Reinecke, IB Reinecke, Munich, Germany

  G: "*Making the European civil engineering education better known and more attractive outside Europe*" Chairperson: Carsten Ahrens, UAS Oldenburg, Germany

  H: "*Developing a synergy between academic and professional worlds"*Chairperson: Colin Kerr , Imperial College London, U.K.
- Reports on the activities of the Working Groups founded in Warsaw for the themes:

  B: *"Enhancement of the cooperation between civil engineering faculties in Europe by the development of joint degrees"* Chairperson: Radu Bancila, Univ. Politehnica Timisoara

  C: "*Doctoral programmes – 3rd cycle – and research in civil engineering faculties"* Chairperson: Marina Pantazidou, NTU Athens

  D: "*Best practice in establishing and running multi-disciplinary programmes of education, involving civil engineering and other fields"* Chairperson: Tudor Bugnariu, TUCE Bucharest

At the end of the meeting Mr. Timo Göbel from the company TIGO-IT, made a demonstration on the new EUCEET web page designed by himself and showed how to develop it.

- *8th meeting of the EUCEET III Management Committee, Zilina, 26 October 2009*

The meeting was organized and hosted by the Zilina University and was attended by the following members of the Management Committee: Prof. Marie-Ange Cammarota, Ecole des Ponts ParisTech, EUCEET III Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Carsten Ahrens, Fachhoschule Oldenburg; Mr. Pierre Michaux, Ecole des Ponts ParisTech; Prof. Richard Kastner, Institut National des Sciences Appliquees Lyon; Prof. Juris Smirnovs, Technical University of Riga; Prof. Radu Bancila, University "Politehnica" Timisoara; Prof. Tudor Bugnariu, Technical University of Civil Engineering Bucharest; Prof. Jan Bujnak, University of Zilina; Prof. David Lloyd Smith and Mr. Colin Kerr, Imperial College London; Prof. Eivind Bratteland, Norwegian University of Science and Technology.

The main points in the agenda, revealed by the minutes, were:

- Information on the results of the meeting in Brussels at EACEA, on 9th September 2009, and on the additional materials to be prepared and sent by 15 November 2009 - Prof.
- Information on the application for the DECELO-EQF project (DEveloping Civil Engineering Learning Outcomes for European Qualifications Framework) submitted for acceptance to the EC on 14th August 2009
- Reports on the state-of-the art of reports for the themes B (Prof. Radu Băncilă), C (Prof. Marina Pantazidou), D (Prof. Tudor Bugnariu), F (Dr. Ralf Reinecke), G (Prof. Carsten Ahrens), H (Colin Kerr)
- Discussion on the EUCEET volumes to be published under EUCEET III
- Discussion on the Programme of the 3rd EUCEET III General Assembly, Paris, 19 – 20 November 2009

- *Third EUCEET III General Assembly, Paris, 19-20 November 2009*

The third EUCEET II General Assembly was organized and hosted by the Ecole Nationale des Ponts Paris Tech. Venue of the General Assembly was the historical building of ENPC located at 28, Rue des Saint Péres, Paris.
The following EUCEET II partners were represented at the General Assembly in Paris: Ecole National des Ponts Paris Tech, Katholieke Universiteit Leuven, Université. Catholique Louvain, Université de Liège, Czech Technical University in Prague, Association of European Civil Engineering Faculties, University of Pardubice, Brno University of Technology, Technical University of Ostrava, Technical University of Denmark, Aalborg Universitet, Technical University Munchen, IB Reinecke GMBH, Technical University Darmstadt, Fachhoschule Oldenburg, Technical University Dresden, National Technical University of Athens, TEI Piraeus, Aristotle University of Thessaloniki, University of Patras, Universidad Politecnica de Madrid, Colegio de Ingenieros de Caminos, Canales y Puertos, Universidade da Corũna, Universidad de Cantabria, Universidad de Castilla la Mancha, Universitat Politecnica de Catalunya, Tallinn University of Technology, Conseil National des Ingenieurs et Scientifiques de France, Institut National des Sciences Appliquees de Lyon, Ecole Nationale des Travaux Publics de l' Etat, Ecole Spéciale des Travaux Publics, du Bâtiment et de l'Industrie, Institut Supérieur du Béton Arme Marseille, University of Dublin Trinity College, University College of Dublin, Politecnico di Milano, Università di Roma Tor Vergata, Università di Trento, Università di Firenze, Università di Pisa, Cyprus Association of Civil Engneers, Technical University of Riga, Latvian Association of Civil Engineers, Lithuanian Association of Civil Engineers, Vilnius Gediminas Technical University, University of Malta, Budapest University of Technology and

Economics, Hungarian Chamber of Engineers, Janus Pannonius University, Delft University of Technology, Graz University of Technology, Wroclaw University of Technology, Warsaw University of Technology, Rzeszow University of Technology, Road & Bridge Research Institute, Byalistok Technical University, Silesian Technical University, Universidade do Porto, Universidade do Minho, University Beira Interior, High Technical Institute of Lisbon, Ordem dos Engenheiros, Laboratorio Nacional de Engenharia Civil – LNEC, University of Maribor, University of Ljubljana, Slovak University of Technology Bratislava, University of Zilina, Helsinki University of Technology, Finnish Association of Civil Engineers RIL, European Council Civil Engineers, Chalmers University of Technology, Loughborough University, City University of London, Imperial College, Cardiff University, Heriot-Watt University, Norwegian University of Science and Technology Trondheim, University of Architecture, Civil Engineering and Geodesie, "Gh. Asachi" Technical University of Iasi, Ovidius University of Constantza, Polytechnic University of Timisoara, Technical University of Cluj-Napoca, Technical University of Civil Engineering Bucharest, Union of Association of Civil Engineers of Romania, Procema RO, Middle East Technical University, Turkish Chamber of Civil Engineers, Istanbul University.

In the opening session, Philippe Courtier, Director of ENPC introduced to the participants Ecole des Ponts ParisTech and greeted them on behalf of the Direction, of the students and of the teaching staff of the School which celebrated in 1997 its 250th anniversary.

The first plenary session was opened by a key-note lecture delivered by Prof. Bernard Vaudeville, Head of Civil Engineering Department Ecole des Ponts Paris Tech, Associate Director TESS Engineering Design Office, who spoke about "*Educating tomorrow's Civil Engineers for a rapidly changing profession*".

In was followed by a General Report on EUCEET III presented by Prof. Marie-Ange Cammarota, EUCEET III Coordinator and Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest.

The General Assembly continued with three parallel sessions:

- of the Working Groups C and G
- of the Working Groups D and F
- of the Working Groups B and H

In the closing plenary session of the first day, there was a general discussion on the future of the EUCEET.

On the second day of the General Assembly, in the morning plenary session, the Chairpersons of the WGs B, C, D, F, G and H presented their final reports.

The last plenary session of the General Assembly was devoted to the round table with the theme: "*Challenges presently faced by the civil engineering education and training*".

The round table was moderated by Prof. David Lloyd Smith, member of the EUCEET III Management Committee, from Imperial College London. Contributions to the round table were brought by Fernando Branco (European Council for Civil Engineers), Guenter Heitmann (Technical University Berlin), Teresa Sanchez Chaparro (Commission des Titres d'Ingénieur) and Bernard Héritier (Eiffage TP).

The last item in the programme of the General Assembly was the key-note lecture presented by Dr. Mike Cook (Buro – Happold) who spoke about "*Teaching and Learning of Design*".

In the concluding remarks of Prof. Iacint Manoliu, thanks were addressed to participants for their active involvement in EUCEET activities, to chairpersons of the Working Groups, to key-note lecturers, to the moderator and contributors to the round table and, last but not least, to Ecole des Ponts ParisTech and to Marie-Ange Cammarota, for the continuous and unvaluable support given to the Project.

- *9th meeting of the EUCEET III Management Committee, Lisbon, 5 February 2010*

The meeting was organized and hosted by the Instituto Superior Tecnico Lisbon and was attended by the following members of the Management Committee: Prof. Marie-Ange Cammarota, Ecole des Ponts Paris Tech, EUCEET III Coordinator; Prof. Iacint Manoliu, Technical University of Civil Engineering Bucharest, Management Committee Chairman; Prof. Carsten Ahrens, Fachhoschule Oldenburg; Mr. Ralf Reinecke, IB-Reinecke GMBH; Prof. Luis Garrote, Technical University of Madrid; Prof. Benjamin Suarez, University Polytechnic Catalunya; Mrs. Amaya Lobo, Universidad de Cantabria; Prof. Roger Frank, Ecole Nationale des Ponts Paris Tech; Prof. Pierre Michaux, Ecole Nationale des Ponts Paris Tech; Prof. Richard Kastner, Institut National des Sciences Appliquees Lyon; Prof. Marina Pantazidou, National Technical University Athens; Prof. Pericles Latinopoulos, Aristotle University Thessaloniki; Prof. Antal Lovas, Budapest University of Technology and Economics; Prof. Gyorgy Farkas, Budapest University of Technology and Economics; Prof. Diego Lo Presti, University of Pisa; Prof. Juris Smirnovs, Technical University of Riga; Prof. Fernando Branco, Technical University Lisbon; Prof. Nicoleta Radulescu, Technical University of Civil Engineering Bucharest; Prof. Jan Bujnak, University of Zilina; Prof. Laurie Boswell, City University; Dr. David Lloyd Smith and Mr. Colin Kerr, Imperial College London; Prof. Feyza Cinicioglu, Istanbul University.

The main points on the agenda were:

- Information on the state of-the-art of the EUCEET Volumes

- Discussions and decisions on the proposal for the Project "*EUCEET Thematic Network – Dissemination of Results",* to be submitted to EACEA by 26th February 2010;
- Discussions on the content of a possible new Thematic Network Project EUCEET and of the application to be submitted to EACEA in February 2011.

Other meetings at which presentations on EUCEET III were made

Presentation on EUCEET objectives and outcomes was made by comprehensive presentations at various meetings:

- The 48th ECCE (European Council of Civil Engineers) meeting, Cyprus, 17 October 2008;
- The 49th ECCE (European Council of Civil Engineers) meeting, Ljubljana, 22 May 2009;
- The 50th ECCE meeting, Helsinki, 16 October 2009.

Annex

Attendance of EUCEET III General Assemblies*

CNTR	NAME	INSTITUTION	Attendance of the GA		
			SANTANDER	WARSAW	PARIS
			15 - 16 March 2007	23 - 24 October 2008	19 - 20 November 2009
Austria	Stephan SEMPRICH	Graz University of Technology	X		
Belgium	Jean BERLAMMONT	KU Leuven	X	X	X
Belgium	Jean-François THIMUS	Université Catholique de Louvain	X		
Brazil	Henrique LINDENBERG	Escola Politecnica da Universidade de Sao Paulo			X
Bulgaria	Kosta MLADENOV	UACEG Sofia			X
Cyprus	Nicos E. NEOCLEOUS	Cyprus Civil Engineering Ass.	X	X	X
Czech Republic	Vaclav KURAZ	Czech Technical University, Prague	X		X
Czech Republic	Yveta LINHARTOVA	University of Pardubice	X	X	X
Czech Republic	Josef MACHACEK	AECEF/ Czech Technical University , Prague	X	X	X
Czech Republic	Alois MATERNA	Technical University of Ostrava	X		
Denmark	Jacob Steen MOLLER	Technical University Denmark Lyngby	X	X	
Denmark	Susanne NIELSEN	Technical University Denmark Lyngby		X	
Denmark	Christian FRIER	University of Aalborg			X
Denmark	Hendrik BROHUS	University of Aalborg	X		
Estonia	Tiit KOPPEL	Tallinn Technical University	X		X
Estonia	Roode LIIAS	Tallinn Technical University	X	X	X
Finland	Aarne JUTILA	Helsinki University of Technology	X		
Finland	Juha PAAVOLA	Helsinki University of Technology		X	X
France	François Gérard BARON	CNISF		X	X
France	Françoise BOURGAIN	Ecole Nationale des Ponts et Chaussées, Paris			X
France	George PILOT	CNISF			X
France	Marie-Ange CAMMAROTA	Ecole Nationale des Ponts et Chaussées, Paris	X	X	X
France	Philippe COURTIER	Ecole Nationale des Ponts et Chaussées, Paris		X	X
France	Roger FRANK	Ecole Nationale des Ponts et Chaussées, Paris		X	X
France	Victor GOMEZ FRIAS	Ecole Nationale des Ponts et Chaussées, Paris			X
France	Pierre MICHAUX	Ecole Nationale des Ponts et Chaussées, Paris			X

CNTR	NAME	INSTITUTION	Attendance of the GA		
			SANTANDER	WARSAW	PARIS
			15 - 16 March 2007	23 - 24 October 2008	19 - 20 November 2009
France	Thibaut SKRZYPEK	Ecole Nationale des Ponts et Chaussées, Paris	X	X	X
France	Bernard VAUDEVILLE	Ecole Nationale des Ponts et Chaussées, Paris			X
France	Bernard HERITIER	Eiffage TP			X
France	André MOREL	ESTP	X	X	X
France	Fabrice EMERIAULT	INSA Lyon	X	X	X
France	Richard KASTNER	INSA Lyon	X	X	X
France	Bernard LE TALLEC	Institut Supérieur du Béton Armé	X	X	X
France	Teresa SANCHEZ CHAPARRO	Commission des Titres d'Ingénieur			X
Germany	Carsten AHRENS	Fachhochschule Oldenburg	X	X	X
Germany	Ulvi ARSLAN	Technical University Darmstadt	X	X	X
Germany	Olivier FISCHER	Technical University Munchen			X
Germany	Christian MUHLBAUER	Technical University Berlin	X		X
Germany	Ralf REINECKE	IB - REINECKE	X	X	X
Germany	Peter RUGE	Technical University Dresden	X		
Greece	Stefanos DRITSOS	University of Patras		X	X
Greece	Pericles LATINOPOULOS	Aristotle University of Thessaloniki	X	X	X
Greece	Aris AVDELAS	Aristotle University of Thessaloniki		X	
Greece	Erikos MOURATIDIS	TEI of Serres		X	X
Greece	Constantine PAPATHEODORU	TEI of Serres		X	X
Greece	Demetrious PAPAGEORGIOU	TEI of Piraeus	X	X	
Greece	Marina PANTAZIDOU	National Technical University of Athens	X	X	X
Hungary	Istvan BODI	Budapest University of Technology and Economics			X
Hungary	Antal LOVAS	Budapest University of Technology and Economics	X	X	X
Hungary	Gyorgy FARKAS	Budapest University of Technology and Economics	X		X
Hungary	Istvan LAZANYI	Budapest University of Technology and Economics			X
Hungary	Joszef MECSI	Hungarian Chamber of Engineers	X	X	
Hungary	Anikó CSÉBFALVI	University of Pécs	X	X	X
Ireland	Brendan O'KELLY	Trinity College	X	X	
Ireland	William MAGETTE	Trinity College	X	X	
Italy	Federico PEROTTI	Politecnico di Milano	X	X	
Italy	Alberto TALIERCIO	Politecnico di Milano			X

CNTR	NAME	INSTITUTION	Attendance of the GA		
			SANTANDER	WARSAW	PARIS
			15 - 16 March 2007	23 - 24 October 2008	19 - 20 November 2009
Italy	Franco MACERI	Universita di Roma "Tor Vergata"			X
Italy	Diego LO PRESTI	Politecnico di Pisa	X	X	X
Italy	Stefano PAGLIARA	University of Pisa	X		
Italy	Luca DESERI	University of Trento		X	
Italy	Riccardo ZANDONINI	University of Trento	X		X
Latvia	Juris NAUDZUNS	Riga Technical University	X		
Latvia	Juris SMIRNOVS	Riga Technical University	X	X	X
Lithuania	Vincentas STRAGYS	Vilnius Gediminas Technical University	X	X	X
Lithuania	Ana ALEKNAVICIENE	Lithuanian Ass. Civil Engineers	X		
Netherlands	Hellen TOUW	Technical University Delft	X	X	X
Norway	Eivind BRATTELAND	Norwegian University of Science and Technology Trondheim	X	X	
Norway	Oivind ARNTSEN	Norwegian University of Science and Technology Trondheim	X		
Poland	Magdalena BRZOZOWSKA	Opole University of Technology		X	
Poland	Piotr BERKOWSKI	Wrocław University of Technology	X	X	
Poland	Marta KOSIOR-KAZBERUK	Bialystok Technical University		X	
Poland	Jerzy PIOTROWSKI	Kielce University of Technology		X	
Poland	Zbigniew RUSIN	Kielce University of Technology		X	
Poland	Zofia KOZYRA	Warsaw University of Technology		X	
Poland	Andrzej MINASOWICZ	Warsaw University of Technology		X	
Poland	Bogumila CHMIELEWSKA	Warsaw University of Technology		X	
Poland	Marta SITEK	Warsaw University of Technology		X	
Poland	Henryk ZOBEL	Warsaw University of Technology		X	
Poland	Wojciech GILEWSKI	Warsaw University of Technology	X	X	X
Poland	Maria KASZYNSKA	University of Szczecin			
Poland	Andrzej LAPKO	Bialystok Technical University	X	X	X
Poland	Stanislaw MAJEWSKI	Silesian Technical University			X
Poland	Szczepan WOLINSKI	Rzeszow University of Technology	X		
Portugal	Joao BARRADAS	Laboratorio Nacional Engenharia Civil, Lisbon		X	X
Portugal	Fernando BRANCO	Instituto Superior Tecnico de Lisboa/ ECCE	X	X	X
Portugal	Alfredo SOEIRO	Universidade do Porto		X	X

CNTR	NAME	INSTITUTION	Attendance of the GA		
			SANTANDER	WARSAW	PARIS
			15 - 16 March 2007	23 - 24 October 2008	19 - 20 November 2009
Portugal	Ryszard KOWALCZYK	University of Beira Interior, Covilha		X	X
Portugal	Joao LEAL	University of Beira Interior, Covilha	X		
Portugal	Luis Jaoquim LEAL LEMOS	Universidade de Coimbra	X		
Romania	Vasilica DIMA	PROCEMA Institute -Bucharest	X	X	X
Romania	Irina LUNGU	Technical University "Gh.Asachi" Iasi	X	X	X
Romania	Nicolae TARANU	Technical University "Gh.Asachi" Iasi	X		X
Romania	Doina VERDES	Technical University Cluj-Napoca	X	X	X
Romania	Tudor BUGNARIU	TUCE Bucharest		X	X
Romania	Mihai DICU	TUCE Bucharest	X		
Romania	Radu DROBOT	TUCE Bucharest	X		
Romania	Doina IRODEL	TUCE Bucharest		X	X
Romania	Iacint MANOLIU	TUCE Bucharest	X	X	X
Romania	Johan NEUNER	TUCE Bucharest			X
Romania	Daniela PREDA	TUCE Bucharest	X		X
Romania	Nicoleta RADULESCU	TUCE Bucharest	X		
Romania	Laurentiu SONIA	TUCE Bucharest	X		
Romania	Andrei VASILESCU	TUCE Bucharest		X	
Romania	Mia TRIFU	TUCE Bucharest			X
Romania	Serban DIMA	UAICR	X		
Romania	Virgil BREABAN	University "Ovidius" Constantza			X
Romania	Radu BANCILA	University "Politehnica" Timisoara	X		X
Romania	Iuliu DIMOIU	University "Politehnica" Timisoara	X		
Slovakia	Jan BUJNAK	University of Zilina	X		X
Slovakia	Josef VICAN	University of Zilina	X	X	X
Slovakia	Jozef DICKÝ	Slovak University of Technology in Bratislava	X	X	X
Slovakia	Alois MATERNA	Technical University Ostrava		X	
Slovenia	Matej FISCHINGER	University of Ljubljana	X		X
Slovenia	Goran TURK	University of Ljubljana		X	
Slovenia	Stojan KRAVANJA	University of Maribor		X	X
Spain	Jose Antonio REVILLA CORTEZON	Colegio de Ingenieros de Caminos, Canales y Puertos			X
Spain	Pedro DIAZ SIMAL	Colegio de Ingenieros de Caminos, Canales y Puertos			X

CNTR	NAME	INSTITUTION	Attendance of the GA		
			SANTANDER	WARSAW	PARIS
			15 - 16 March 2007	23 - 24 October 2008	19 - 20 November 2009
Spain	Edelmiro Rua ALVAREZ	Colegio de Ingenieros de Caminos, Canales y Puertos	X		
Spain	José Luis Juan ARACIL	Colegio de Ingenieros de Caminos, Canales y Puertos	X		
Spain	Jesus Granero MEGIAS	Colegio de Ingenieros de Caminos, Canales y Puertos		X	
Spain	Pedro Rodriguez HERRANZ	Colegio de Ingenieros de Caminos, Canales y Puertos	X	X	
Spain	Rafael BLAZQUEZ	Universidad de Castilla La Mancha	X		X
Spain	Luis GARROTE	Universidad Politecnica de Madrid		X	X
Spain	Francisco Martin CARRASCO	Universidad Politecnica de Madrid	X		
Spain	Pedro Fernandez CARRASCO	Universidad Politecnica de Madrid	X		
Spain	Luis GARROTE	Universidad Politecnica de Madrid	X		
Spain	Soledad NOGUÉS LINARES	Universidad de Cantabria, Santander	X		
Spain	Pedro SERRANO	Universidad de Cantabria, Santander			X
Spain	Xavier SANCHEZ-VILA	Universidad Politecnica Catalunya, Barcelona	X		
Spain	Benjamin SUAREZ ARROYO	Universidad Politecnica Catalunya, Barcelona	X		X
Spain	Maria HAUSEN	Spanish Association for Earthquake Engineering			X
Spain	Amaya LOBO	University of Cantabria, Santander		X	X
Turkey	Ilknur BOZBEY	Istanbul University	X		
Turkey	Feyza CINICIOGLU	Istanbul University	X	X	
Turkey	Cenk ALHAN	Istanbul University	X		X
Turkey	Cevza Melek ALHAN KAZEZYILMAZ	Istanbul University			X
Turkey	Tugrul TANKUT	Turkish Chamber of Civil Eng.	X	X	
Turkey	Ozgur YAMAN	Middle East Technical University		X	
UK	Laurie BOSWELL	City University of London	X	X	
UK	Uma PATEL	City University of London		X	
UK	Colin J. KERR	Imperial College London	X	X	X
UK	David LLOYD SMITH	Imperial College London	X	X	X
UK	Ian MAY	Heriot Watt University	X	X	X
UK	Alan KWAN	Cardiff University	X	X	
UK	Mohammed RAOOF	Loughborough University	X		
UK	Mike COOK	Buro Happold, London			X

*The alphabetical order of countries was adopted

THEME C: Doctoral programmes – 3rd cycle – and research in civil engineering faculties

Report of the
Working Group

THEME C: DOCTORAL EDUCATION & SKILLS TRAINING IN CIVIL ENGINEERING FACULTIES

Report of Working Group
Marina PANTAZIDOU[1]

1. INTRODUCTION

The work presented in this article summarizes the results of the activities undertaken by Work Group C of the EUCEET (European University Civil Engineering Education and Training) network. The work belongs in the theme "Doctoral programs – 3rd cycle – and research in civil engineering faculties". Within this theme, Work Group C focused on doctoral education, given the interest it has attracted at the European Union level in recent years. The scope of work was fourfold. (I) Review of policy trends and position papers in Europe and the USA, in order to identify recommended changes to the education component of doctoral programs, focusing in particular on skills development (Section 2). (II) A synthesis of information, from publications and the Internet, concerning trends pertaining to skills training in engineering and, when available, civil engineering in particular (Section 3). The information in Sections 2 and 3 was supplemented with examples from the home institutions of work group members. (III) A study on attitudes related to skills training, which included an opinion poll among the members of Group C, as well as literature search (Section 4). (IV) Adaptation of existing seminar materials and development of new ones that target specifically an audience of civil engineering doctoral students (Section 5). Traces of group work (meeting minutes etc.) and its products (seminar materials) are included in the group's website (http://www.euceet.eu/workgroups/c/index.php?id=78) and tabulated in the Appendix.

2. DOCTORAL EDUCATION TRENDS

This article deals primarily with the traditional PhD model and does not concern itself with the professional doctorate. Literature review reveals significant variability in the standards of these doctorates compared to the traditional PhD degree, especially across disciplines (CGS, 2007). In engineering, however, it appears that most often the same standards apply to

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both PhD degrees in terms of the outcome. The main difference is the involvement of industry in a professional doctorate, either through the advising committee, which may include representatives from business or consulting, or through a direct link between the doctoral candidate and a company. Lately, the term "Collaborative Doctoral Education" has been used in order to stress industry involvement (EUA, 2009). For the remaining of this article, the professional doctorate will not be discussed, with the exception of considerations regarding skills training (see Section 4.2).

2.1 Doctoral Education trends in Europe

In searching for trends, an effort was made to identify both promulgated outcomes and materialized trends. Hence, material reviewed included policy statements issued by European Ministers, assessment and recommendations put forth by academic bodies, as well as information describing changes already in place at European engineering schools.

The Bologna Declaration by the European Ministers of Education (1999) is a suitable starting point for the review. In the declaration, the Ministers affirmed their agreement to construct a "European Area of Higher Education" (EAHE), characterized by comparability of degrees, two main cycles of studies (undergraduate and graduate) and a uniform system of credits in order to promote mobility. Additional objectives included promotion of curricular development, inter-institutional cooperation, mobility schemes, and programs integrating study, training and research.

2.1.1 Scope of Doctoral Education

Recognizing the need for closer links between the European Area of Higher Education and the European Research Area, the European Ministers Responsible for Higher Education (2003), in their conference in Berlin, expanded the scope of the Bologna Declaration and included the doctoral level as a third cycle in the EAHE. The written outcome of the conference, known as Berlin communiqué, identified three concurrent goals of doctoral programs, namely, (i) producing research output, (ii) providing research training, and (iii) promoting interdisciplinarity. To achieve these goals, the ministers stressed the need for inter-institutional collaboration and pledged support of networks at the doctoral level.

The acknowledgment of research training as a distinct goal, separate from the activity of research itself, brought doctoral education to the forefront. Then, in 2005, the Bergen communiqué called for defining doctoral-level qualifications based on outcomes and identified the need for structured doctoral programs. These structured programs should promote both interdisciplinary training and development of transferable skills, in order to equip the graduates for a variety of employment opportunities. The special nature of PhD studies, which are geared toward the production of new knowledge, was recognized by the Bergen communiqué, which emphasized that overregulation of doctoral programs should be avoided. This advice was reiterated two years later in the London communiqué. Acknowledging the valuable contribution of doctoral students to the European research capacity, the European Ministers Responsible for Higher Education (2007) emphasized the need to improve the status and career prospects of doctoral candidates with a variety of measures, including development of transferable skills. The need to support the career development of doctoral candidates was again stressed in the most recent communiqué from the 2009 conference in Leuven.

The re-evaluation of doctoral studies by this series of policy statements placed doctoral candidates at the center of interest. To many, adopting the perspective of the students' best interests leads to the requirement of structured doctoral studies. The following two sections discuss two ways of providing structure to doctoral studies, through their administration and through coursework.

2.1.2 Administration of Doctoral Education

The aforementioned deliberations of the Ministers of Education were guided to some extent by concurrent studies of academic bodies, most notably the European University Association (EUA) (www.eua.be), which ran several projects focused on doctoral education. To consolidate these efforts, EUA went ahead to create the EUA Council on Doctorate Education (EUA-CDE), which organized an inaugural conference in 2008, followed by several thematic conferences (http://www.eua.be/events/eua-council-for-doctoral-education/meetings-and-events/).

Studying the structure and organization of doctoral programs was one of the first projects undertaken by EUA (2005). The project found considerable diversity, among countries, among universities in the same country, and among departments in the same university. In some countries, regulations for doctoral programs exist at the national level, while in others, in the absence of such regulations, responsibility is left with departments. EUA (2005) notes that organization of doctoral studies by the department alone may not support an adequate research environment and recommends administrative management of doctoral programs at the university level.

Many universities have moved towards this direction and established graduate or doctoral schools, which typically specify the structure and the regulations of doctoral studies, including coursework requirements. According to a recent EUA (2007) report, 16 out of the 37 European countries reviewed have established doctoral or graduate schools for the organization of doctoral education. However, only in three countries doctoral schools is the sole organizational structure (France, Liechtenstein, Turkey). The interested reader will find in the EUA (2007) report a long list of the added value of doctoral/graduate schools.

Among the technical universities in Europe that have established doctoral schools is the Doctoral School Lausanne EPFL, Switzerland (http://phd.epfl.ch/), which was created in 2003 and became obligatory for all incoming students in 2006. Chalmers University of Technology, Sweden, has organized doctoral programs in the form of graduate schools since 2005. Each graduate school at Chalmers is either organized within a department or is common to a number of departments (http://www.chalmers.se/en/sections/education/doctoral_programmes/graduate-schools). Among universities with a strong emphasis on engineering, Aalborg University, Denmark, has established a doctoral school since 1993 (http://phd.ins.aau.dk/). The doctoral school is further subdivided in ten doctoral programs, including one in civil engineering, which is offered jointly by the department of civil engineering and the department of developing and planning (http://phd.ins.aau.dk/phd-study-engineering-science-medicine/3781564). Larger universities have grouped resources of departments in related disciplines. As an example, KU Leuven, Belgium, established three doctoral schools, one of which is the Arenberg Doctoral School for the faculties of Science, Engineering and Technology (http://set.kuleuven.be/phd/). The Arenberg Doctoral School started in 2007 and, as acknowledged by faculty members of KU Leuven, has yet to reach a steady state of operations.

Review of the websites of the doctoral schools mentioned above indicates that a common model emerges. The doctoral school sets forth general regulations for PhD studies, organizes and/or publicizes general graduate courses and provides a central repository of information and advice for PhD students. What the review of the websites cannot tell is whether the structure offered by the doctoral schools is felt as imposed on the departments by a separate body, or whether the two administrative structures are interwoven and felt as complementary. Clearly, the integration of a doctoral school in the administrative structure of the university must be related to the length of the time period it is in operation.

2.1.3 Coursework

To many, the defining characteristic of a PhD program is the apprenticeship of PhD candidates by their supervisors. Coursework complements this core and is designed primarily to equip the PhD candidate with the tools to conduct research, but also for the career beyond the PhD.

Most universities in Europe have shifted from pure apprenticeship to a combination of individual supervision and coursework. A survey by EUA (2007) showed that only five countries out of the 37 polled still adhere uniformly to individual supervision. However, a concurrent survey by the TREE (Teaching and Research in Engineering in Europe) network of engineering schools gave a higher percentage: in 33% of the polled institutions individual supervision is the norm (Avdelas, 2007). Meanwhile, more than half (59%) of the participating engineering schools have included coursework requirements in doctoral programs. The TREE survey also provided information of the type of coursework offered. An overwhelming majority of the course-offering institutions (89%) offers specialization-oriented courses (e.g. Advanced design of steel structures), while a smaller, yet sizeable, percentage (79%) offers research-oriented courses (e.g. Constitutive relations in geo-mechanics). About half the institutions (49%) offer general introductory courses (e.g. Applied informatics). Finally, a small minority offers courses oriented toward career development (14%) and ethics (7%).

As mentioned, coursework is intended to develop competences necessary for research, but also useful for the future career paths of doctorate holders. At a time when few PhD degrees were awarded, it was a fair assumption that the anticipated career was most probably going to be in academia. However, this is not the case anymore. Hence, efforts are made to offer training for the development of transferable skills, which, according to some institutions at least, better prepare students for their studies, research and further career (e.g. http://phd.epfl.ch/).

It would be wrong to conclude that the tendency towards a structured doctoral program is a recent development or that it is a result of recommendations at the European Union level. The concern to enhance doctoral programs was codified in law in Flanders as early as 1991 (Mathieu and Adams, 1997). The law specified that doctoral students should obtain a minimum of 60 credits, corresponding to a study load of one full academic year. In the University of Antwerpen, these 60 credits would be divided in 20 credits of research-related activities (publishing papers, participating in conferences, etc.), 20 credits on courses within the discipline and 20 courses on particular technical and social skills (Management, Computer programming, History of science, etc.). (Note that the University of Antwerpen does not have an engineering school.) When this information was presented by Mathieu and Adams (1997), the doctoral study program at Antwerp had run for a period of three academic years, after which both students and academic staff agreed that the additional course effort did not compromise quality or quantity of research. Despite these early positive opinions, a recent visit to the website of the University of Antwerpen shows that the requirement of the 60 credits has gone down to 30 credits (University of Antwerpen, 2009).

In concluding this section, it should be emphasized that the two ways discussed for providing structure to doctoral education are complementary. Organizing doctoral education around doctoral schools facilitates offering of skills development seminars to doctoral students from different departments.

Organization of doctoral education around doctoral schools also allows pooling of resources for the teaching of specialized graduate courses. This model is applied in Italy (Lo Presti and Silvestri, 2008). The Doctoral School in Geotechnical Engineering, a consortium of all the universities in the Campania region that offers a specific curriculum in Geotechnical Engineering, is an example of this model. A number of courses is mandatory, selected to suit each student's study. Students can enroll in courses offered in any one of the universities forming the consortium. Likewise, a Doctoral School in Structural Engineering and Architecture has been established in 1994 by the universities of Trento (coordinating university), Padova, Venezia, Brescia, Trieste and Udine. Funding is available for students to take courses in the different campuses.

2.2 Doctoral Education trends in the USA

In the absence of a centralized policy-setting body for doctoral studies in the USA, the review for policy documents focused primarily on academic bodies, such as the Association of American Universities (AAU) (www.aau.edu) and the Council of Graduate Schools (CGS) (www.cgsnet.org). Most of the documents reviewed note the elevated status of American universities, in general, and doctoral programs, in particular; however, there is also agreement that this high standing should not lead to complacency. If there were one single starting point for re-thinking PhD education in the US, this would be the changes in the market place for doctorate holders, which entail increasing percentages going on to non-academic and non-research careers. Taken all the reviewed documents together, it would be fairer to say that the re-examination of doctoral education is undertaken with the dual goal of enriching the PhD experience, as well as of improving the quality of the research work force.

2.2.1 Scope of Doctoral Education

In a policy statement for the Doctor of Philosophy Degree, CGS (2005) stresses that the design of a PhD program aims at training doctoral students to become scholars ("that is, to discover, integrate and apply knowledge as well as to communicate and disseminate it"), thus preparing them for a range of subsequent careers. Doctoral programs do involve some amount of coursework and, according to the statement, should also offer resources for teaching and professional development. However, it is recognized that the basic attitudes and skills of a scholar are developed by apprenticeship. This timeless consideration of a PhD program may be adjusted further by taking into account the needs of the market.

Nearly 15 years ago, the Committee on Science, Engineering and Public Policy (COSEPUP) of the National Academies of Sciences and Engineering prepared a report with recommended changes for PhD education, in response to changing career prospects of science and engineering PhDs (COSEPUP, 1995). The report considered alternative recommendations, including the creation of a new type of doctorate; however, it was felt that original research, i.e. the core of the traditional PhD, should be preserved as a fundamental feature of the PhD degree. Instead, the committee recommended that changes should be directed to producing more versatile scientists and engineers, with a wider variety of skills. The report stressed that the primary objective of graduate education is the education of students. Consequently, it urged for controlling time required to complete a PhD, through judging all activities of doctoral students by the degree to which each activity contributes to the students' education. The pre-eminence of student interests is reiterated by AAU (1998), which recommends re-evaluation of the graduate curriculum with the aim of equipping the students with the knowledge and skills needed for a variety of career paths. More recently, Akay (2008) returned the discussion to the need for combined depth and breadth, and argued for the added value of non-technical attributes of PhD graduates. Akay rightly remarks that the desired breadth of knowledge and expertise required from PhD graduates cannot be provided by their advisors alone and, hence, argues for the necessity of organizational structures facilitating co-operation among departments and with the industry.

Another avenue for trend setting in the US is large projects funded by prestigious non-profit foundations. The most recent completed project related to doctoral studies appears to be the Carnegie Initiative for the Doctorate (CID), funded by the Carnegie Foundation for the Advancement of Teaching. The CID focused on six fields of study: chemistry, education, English, history, mathematics, and neuroscience. Participating departments undertook several innovations, which are placed in a "digital gallery" of the CID program (http://gallery.carnegiefoundation.org/cid/). Although no engineering department participated, some innovative practices can be gleaned from related fields, such as chemistry, as will be discussed in some detail in Section 2.2.3.

2.2.2 Administration of Doctoral Education

Doctoral studies are organized through the graduate division, which establishes requirements and standards for the PhD degree. The graduate dean shares responsibility with departments for the quality of doctoral studies, but the relative magnitude of the responsibility varies across universities (CGS, 2005). Walker (2008) considers the detailed understanding of the organization of doctoral education at research universities in the US to be a precondition for understanding and minimizing the conflicts of purpose and governance between graduate division and individual departments. In theory, it is up to the graduate division to take the lead in placing "graduate student scholarly formation at the heart of the doctoral programs". In practice, however, it is difficult for the graduate division to make a difference, because it typically is a weak unit, without much clout or significant budget. In order to effect any changes, Walker (2008) proposes that the graduate dean seek support from or make alliances with other, more powerful administrative units, such as the office of the research vice-president. Akay (2008), on the other hand, suggests establishing clear incentives for PhD education, separate from research, in order to resolve the conflicts of interest between PhD education and institutional needs for research output and teaching support.

2.2.3 Coursework

The well-established American model for doctoral studies, which combines coursework and research, has been in place already by the end of the 19^{th} century [(Walters, 1965), referenced in Thurgood et al. (2006)]. The graduate division may or may not specify course requirements, thus leaving the responsibility to individual departments. In most cases, required coursework is selected from the field of the student's research area and related fields (e.g. mathematics) and may vary in length between two and four semesters of full course load.

Despite this long tradition of requiring thematic coursework for doctoral studies in the US, the voices calling for change may have the effect of widening the spectrum of graduate courses. Akay (2008) argues for the need to broaden the skills of PhD engineering graduates, emphasizing non-technical skills. Akay acknowledges the fears that including non-technical skills in engineering graduate programs would undermine their strength or lead to loss of focus on research. Nevertheless, considering more important the need to have PhDs with the full complement of professional skills necessary for success in academe, business, or government, he seems to believe that it is possible to address this need as an optimization problem under constraints. According to AAU (1998), one such constraint is that adding breadth to depth should not increase the time required for degree completion.

The advocated changes described above have started being applied in some universities. As part of its participation in the Carnegie Initiative mentioned in Section 2.2.1, the Department of Chemistry at Howard University has instituted two curricular innovations. These are presented herein in some detail, in order to illustrate the point that some improvements can be made with only minor adjustments of existing practices. The first innovation is adoption of a flexible curriculum, which reduces to 15 hours chemistry coursework taken prior to starting research work and allows for a student-specific mix of courses. Beyond the 15 hours of chemistry coursework, students can take non-chemistry courses, based on their needs and the recommendation of their research advisor and/or advisory committee, in order to make up the 36 hours of coursework required by the graduate school (corresponding to three semesters of full course load). These additional courses could be selected from disciplines such as

Biochemistry and Pharmaceutical Sciences, but also Teaching, Communication, etc., thus, creating opportunities for training and research interdisciplinarity. Another curricular innovation is the integration of professional development into the curriculum, with measures such as requiring that the dissertation proposal be written in the form of a grant application, which could then be used as a basis for the application for candidacy. In addition, the Department of Chemistry at Howard has made a requirement for Ph.D. candidacy that students enroll in at least one professional development course. One course that can fulfil this requirement is a course on Preparing Future Faculty, covering topics such as: Responsible conduct of research, Ethical case studies, Communication skills, Grantsmanship, Teaching and learning as a scholarly activity (http://gallery.carnegiefoundation.org/collections/cid/chemistry/howard/innovation.html).

Training seminars on topics that would fall in the transferable skills category in Europe would most probably be listed as professional development seminars in the US. As mentioned, CGS (2005) considers teaching and professional development resources among the administrative services and physical facilities required for doctoral programs. All big universities in the US have both a teaching and a career center, which offer advice and seminars for students. Differences among universities arise from the capacity of these centers: some universities have centers conducting research on education as well as offering teaching guidance and, hence, provide a richer environment for their graduate students contemplating academic careers. Other differences arise by the perceived link (or absence of it) between career services and the graduate division and, again, by the capacity of the career center. During the resources review for this report, it was found that the work of the University of Chicago Career Advising and Planning Services (CAPS) (https://caps.uchicago.edu/) is referenced widely by career centers of other universities in the US and Canada. Among its many pamphlets with advise to students, the one most relevant to this report is titled "Skills identification for graduate students and postdocs" (CAPS, 2007), which helps graduate students identify transferable skills developed during teaching, as shown in Table 1.

When it comes to resources available to graduate students, those offered by the Rackham Graduate School of the University of Michigan (http://www.rackham.umich.edu/) are among the most comprehensive. By selecting additional courses, graduate students can receive, apart from their PhD degree, a certificate in a variety of domains. Some of these certificate programs are ideal for an academic or research career. Examples include the Certificate in Engineering Education Research (http://www.engin.umich.edu/teaching/crltnorth/rackhamcert.html) and the Certificate in Science, Technology and Public Policy (http://www.stpp.fordschool.umich.edu/grad.html). The Rackham Graduate School also offers dissertation and career resources and, in collaboration with other university units, seminars on teaching (offered by the Center for Research on Learning and Teaching) and opportunities for statistical consultation (offered by the Center for Statistical Consultation and Research). The central repository of information and support provided by the Rackham Graduate School conveys the impression that all activities covered are part of graduate studies and not some outside supplement students should independently seek at the university's career center (which, incidentally, also exists at the University of Michigan and offers its services to graduate students).

Table 1. Skills developed by teaching an introductory writing course for undergraduate students (CAPS, 2007).

Tasks	Prepare syllabus Order books Plan and organize lessons Photocopy material for students Prepare lectures and discussions Answer questions, prepare exams, graded papers Evaluate student progress (as a class and individually) Meet with students privately to discuss their progress
Skills	Organization Planning and scheduling Public speaking Translating new concepts to new learners and old concepts in new and interesting ways Interpersonal skills (small and large group skills) Diplomacy Managing groups of people in leading discussions

2.3 Summary

On both sides of the Atlantic, attention is called to the formal training of doctoral students, which will equip them for a variety of careers. While most European universities have adopted the American model of requiring coursework for doctoral studies, some have gone further and included seminars for transferable skills training. Such training is still in the category "professional development" in the US and, when offered in the form of seminars and not one-to-one advice, is organized by university career centers. However, there are a few instances where a proportion of broader-scope coursework finds its place in formal doctoral curricula in American universities as well.

3. TRANSFERABLE SKILLS TRAINING

3.1 Definition

For the purposes of doctoral education, the following definition is given for **transferable skills**, in a form complying with terminology standards ISO 704 and 10241:

abilities enhanced or obtained during postgraduate research that are useful to many different kinds of professional roles

NOTE 1 – Such skills are sometimes referred to as ‘horizontal’ or ‘soft’.
NOTE 2 – Professional roles refer to either academic or non-academic careers.

The following section provides examples of transferable skills, as well as of seminars on transferable skills offered at European universities.

3.2 Examples

3.2.1 Cardiff University

Cardiff University has established an extensive program for the development of skills of research students. The program of the seminars was developed jointly by Cardiff’s Graduate Center and its four Research and Graduate Schools in Biomedical and Life Sciences, Humanities, Physical Sciences and Engineering, and Social Sciences. Over 200 topics are available: some suitable for all research students, others targeting students of a particular graduate school. Seminars offered belong in seven skills categories, listed with corresponding example seminars in Table 2. The seven categories originate from a joint statement issued by Research Councils UK (RCUK) and the Art and Humanities Research Council (AHRC). The joint statement describes the skills that students funded by RCUK and AHRC are expected to develop during their research training (http://www.cf.ac.uk/gradc/training/skillsdevprogramme/joint/index.html).

With the exception of the Personal Effectiveness category, which includes seminars presented by consultants and addressed to all students, the other categories mostly include seminars that target audiences from one of the four graduate schools. Table 2 includes seminars for either all audiences or suitable for engineering students.

Seminars are presented by members of the faculty, employees of university support units (e.g. information services), or consultants. Seminar duration ranges from a single meeting of 2-3 hours or multiple meetings of 2-3 hours, to 1-3 full days. The information provided for each seminar varies: some have only a paragraph-long description; others are described both in terms of contents and the intended learning outcomes. The format of the seminars varies as well: some are mainly intended for information giving, while some others combine information with discussion and feedback. Most seminars, though, require the active participation of students. All this information is provided in the seminar catalogue (www.cardiff.ac.uk/rssdp), together with recommendation to the students on whether a course is appropriate for the early, middle or late stages of doctoral research.

Table 2. Skills categories and example seminars at Cardiff University for the academic year 2009-2010 (www.cardiff.ac.uk/rssdp).

Skill	Seminar
(1) **Research Skills & Techniques**	• Applied Statistics for Physical Scientists and Engineers
(2) **Research Environment**	• Finding Funding • Fair Practice and Good Writing in Academic Practice
(3) **Research Management**	• Intelligent Web Searching for Research • Identifying and Writing High Quality Papers: Appraisal Techniques and Checklists • Computer Programming (various topics)
(4) **Personal Effectiveness**	• Creative Thinking & Problem Solving in Research • Managing Stress in the PhD
(5) **Communication**	• Organizing a Conference • Media Training for Researchers • Writing & Literature Skills in the Physical Sciences & Engineering • Teaching Skills (various topics)
(6) **Networking & Team working**	• Managing your Research Supervisor • Selecting a Conference, Presenting & Networking
(7) **Career Management**	• Developing an Academic Career in the Sciences and Engineering • Career Planning for Researchers in the Sciences & Engineering – Exploring your Options beyond Academia

Selection from the available offerings is guided by a development needs analysis (http://www.cf.ac.uk/gradc/resources/RSSDP%20Pull%20Out%20FINAL.pdf). The needs analysis consists of rating specific abilities, which correspond to each of the seven categories of Table 2, first by the research students on their own and then in consultation with their supervisor. Guided by this assessment, students set priorities of abilities to be developed by a variety of activities, including attending seminars.

3.2.2 Katholieke Universiteit, Leuven (KU Leuven)

The process of seminar selection at KU Leuven also should start with drafting a personal competence profile, which helps to identify the most relevant skills that have to be acquired or refined, according to the students' needs and/or interests. This competence profile for doctoral students was developed by KU Leuven based on surveys with representatives from various sectors (private, education and government) and includes five broad categories of skills: (1) academic & technical, (2) intellectual, (3) leadership & change management, (4) relational, (5) self management. These five categories of skills and competences were adopted in the work of Group C, and they will be discussed further in Section 4.1.

Course offerings are announced online (http://set.kuleuven.be/phd/skills.htm), typically a few months before they become available. Similarly to Cardiff, seminars differ in the affiliation of presenters (faculty, KU Leuven employees, or consultants), in the delivery format (informational or requiring active participation by students), in the duration (few-hour meeting once, few-hour meetings over several weeks, day-long or week-long) and in the targeted audience (early, middle or late stage of the doctoral research). It should be noted that most seminars are delivered in English, but a few are listed and hence, presumably, delivered in Dutch.

Table 3. Example entries from skills and competences calendar of seminars offered at KU Leuven (http://set.kuleuven.be/phd/skills.htm, accessed Dec. 13, 2009).

Major category of skills and competences	Seminar theme	Seminar topic
(1) **Academic & technical skills**	Scientific tools	• Safety in Research • Statistics
	Technical skills	• Information Technology (various)
	Information & publication skills	• Information Literacy Course
	Good scientific conduct	• Science Ethics • Scientific Integrity
	Didactic skills	• Student Coaching
(3) **Leadership & change management**	Entrepreneurship	• Exploitation of Research /Technology & Knowledge Transfer
(4) **Relational skills**	Interpersonal skills	• Meeting Skills • Assertive Communication & Active Listening
	Communication skills	• Scientific Writing [also belongs in (1)] • Writing for the Public (in Dutch)
(5) **Self management skills**	Strategic skills	• Managing your PhD
	Career management	• Writing a CV • Job Interview Training

Table 3 gives some indicative examples of seminars offered by the Arenberg Doctoral School. Seminars are listed in groups or themes, which neither correspond directly to, nor fall clearly under the five super-categories of KU Leuven's competence profile. For clarity of presentation in this report, a correspondence between the five categories and the seminar groups was hypothesized and is indicated in Table 3. Although Table 3 does not give a comprehensive list of seminar offerings, it is fairly representative of the relative proportion of seminar categories: the majority of offered seminars are related to academic and technical skills.

3.2.3 Other examples of Skills Training

This section makes reference to seminar offerings for engineering doctoral students at a few more universities, mainly technical, with the aim of allowing some comparisons (and not of presenting seminar programs in any detail). In the UK, most universities offer skills training, since transferable skills is a requirement of research funding agencies (recall the joint statement by RCUK and AHRC mentioned in Section 3.2.1). Naturally, the same joint statement is referenced by several UK universities and guided, to various degrees, the development of seminars offered. The Graduate School of Engineering and Physical Sciences at Imperial College offers to its students a wide range of seminars (http://www3.imperial.ac.uk/gseps/transferableskillscourses), comparable in diversity and scope to the program at Cardiff University. Oxford University has set up a skills portal (http://www.skillsportal.ox.ac.uk/), which includes an introduction of the concept of transferable skills and reports on the importance of these skills for PhD graduates. The portal lists resources for both research students and research staff. It also includes resources for supervisors, who are encouraged to become familiar with the resources provided to the students and staff under their supervision. Interestingly, the skills portal is under Career Services at the University of Oxford.

It is important to stress before closing the discussion on UK universities that the interest in training of researchers in the UK goes back to an influential report produced by Sir Gareth Roberts, who was asked by State Secretaries to produce a review into the supply of science and engineering skills in the UK (http://www.hm-treasury.gov.uk/ent_res_roberts.htm). From this review, which is known as the Roberts review, it becomes apparent that only a small percentage of contract research staff has received training for research-related skills (e.g. project/finance management). This centrally-originating concern is perhaps the explanation for the existence of national organizations that provide skills training for early career researchers from all universities in the UK (e.g. http://www.vitae.ac.uk/policy-practice/1403/GRADschools.html). The remainder of this section makes reference to skills training in the institutions mentioned in Section 2.1.2.

The website of the Doctoral School Lausanne EPFL discusses the various skills gained in a doctorate, according to EPFL's teaching body, which agreed that there are three main groups of skills: (i) methodological: formulating a problem and knowing how to work towards its solution, (ii) knowledge-based: learning and generating scientific knowledge and (iii) transferable: the “soft skills” that can rarely be taught but are developed in the work of research, and which are improved by taking part in training courses (http://phd.epfl.ch/page80940.html). This seems to be the only place where methodological issues are mentioned for engineering. Unfortunately, the specific correspondence between the three skills groups and the seminars offered is neither described, nor is it clear. Instead, seminars offered at EPFL are grouped under the following headings: (1) communication (oral and written), (2) research skills, (3) teaching skills and (4) preparing for a career.

The website of the Civil and Environmental Engineering Graduate School at Chalmers does not make an explicit reference to transferable skills. Nevertheless, it lists such courses among the required (Teaching methods, Ethics) and elective courses (Information retrieval and information processing, Academic writing for PhD students). The course requirements for the PhD degree at Chalmers amount to 60 higher education credits, corresponding to one full year. The aforementioned courses have 3 credits each, fewer than the listed technical courses, which have 4.5-7.5 credits.

The required course load at Aalborg University for PhD students corresponds to half a year (30 credits). Courses are listed by graduate school, while there is also a "General Courses" category (http://adm.aau.dk/fak-tekn/phd/kurser/index.htm) of about 15 courses. A couple of these general courses are technical (e.g. Problems of advanced optimization), while the rest can be characterized as seminars on transferable skills (e.g. Patenting and commercialization, Library information management, Writing and reviewing scientific papers). The skills seminars last from one to three days and correspond to 1-3.75 credits. It should be stressed that Aalborg University has a unique distinction: apart from seminars for PhD students, it also offers a course for PhD supervisors, the overall objective of which is to improve the quality of PhD supervision.

3.3 Discussion

This section defined transferable skills and gave examples of seminars offered to doctoral students for the enhancement of such skills. It is understood that development of transferable skills should be part of all three cycles of higher education (EUA, 2007). Specifically for doctoral students, EUA (2007) states that the main goal of such training is to "raise awareness among doctoral candidates of the importance of both recognizing and enhancing the skills that they develop and acquire through research, as a means of improving their employment prospects both in academia and on the wider labor market". In other words, seminars offered should not necessarily be viewed as "teaching" transferable skills. An important role of the seminars is to help PhD students become aware of skills developed by performing the tasks associated with their research and teaching duties (EUA, 2009), along the lines of the example provided in Table 1.

A comparison of seminars offered at several universities in Europe, which make this information available on the Internet, indicated the following. Universities in the UK have the most extensive programs of transferable skills training, as a result of requirements by research funding agencies, which have identified seven categories of desirable skills. Since these programs are fairly recent, a relative uniformity may facilitate future assessment of the programs' outcomes. Different skills taxonomies are used in universities in other countries, while sometimes the intended correspondence between skills category and seminars offered is not apparent. Although the categories employed do not differ in any fundamental way, the analysis of a category in subcategories conveys the message that the distinction is important. Table 4 shows the correspondence between the skills categories used by UK universities and at KU Leuven.

Table 4. Comparison of skills categories at UK universities and KU Leuven.

UK universities	KU Leuven
Research Skills & Techniques	Academic & Technical Skills
Research Environment	
Research Management	
Personal Effectiveness	Leadership & Time Management
	Self Management Skills
X	Intellectual Skills
Communication	Relational Skills
Networking & Team working	
Career Management	X

Note: X = equivalent category is missing

One could argue that Academic & Technical Skills as well as Relational Skills are given more attention in the UK, since they are divided in subcategories, while the opposite may be true for Personal Effectiveness Skills. Moreover, the Intellectual Skills (KU Leuven) and the Career Management (UK universities) categories have no counterparts. Future work should investigate the possibility of compiling a unified taxonomy of transferable skills.

It is interesting to note that seminar offerings reviewed do not include any seminar on Research Methodology for Engineering. This lack becomes apparent when making comparisons to fields such as humanities and biomedical sciences (by perusing Cardiff's offerings, for example). Examples of methodology seminars could cover topics such as Research strategies for engineering or Hypothesis generating and testing for engineering. Different reasons could be suggested to account for this lack of systematic training in the fundamental aspects of engineering research: research methods in engineering may be considered as "objective" (as opposed to, say, in the humanities) or too well established to be explicitly taught. Another possibility is that research methods in engineering have not been explored systematically enough to be taught. Future work must investigate the reasons of this instruction gap.

4. ATTITUDES TOWARDS SKILLS TRAINING

4.1 Survey on Skills Training

4.1.1 Questionnaire structure

This section describes the survey performed to identify the opinions of the members of Group C regarding skills training. For this purpose, the taxonomy of transferable skills used at KU Leuven (Section 3.2.2), was adapted, as shown in Table 5, and a questionnaire was developed, part of which is reproduced in Table 6.

The aim of the survey was twofold: (i) to detect any disagreements between university requirements for skills training and beliefs of faculty members and (ii) to identify seminar topics considered by Group C members as good candidates for seminar development through group work or through future projects involving international collaborations. The decision to investigate faculty beliefs was a result of the first meeting of the group, which took place in October 2008 at the Technical University in Warsaw. Group discussion revealed significant differences in training offerings among the institutions represented in the group. In addition, concerns were voiced regarding taking too much time out of research for skills training.

The questionnaire was accompanied by an introductory text, meant to bring all faculty members on the "same page", regardless of whether their home institution offers skills training seminars or not. The introductory text included the definition of transferable skills given in Section 3.1, a short section on transferable skills development from EUA (2007) and Table 5.

Table 5 is an attempt to give a comprehensive competence profile of an engineering PhD graduate. To this end, research-related skills (or thematic training) category (1), is added to the five transferable skills categories used at KU Leuven, numbered (2) through (6). Research-related skills can further be distinguished to competences specific to particular research topics (e.g. constitutive modelling) and those related to engineering tools of wide applicability (e.g. numerical analysis). Statistical analysis, listed under category (2), can also be considered an engineering tool, and, in retrospect, should have been moved to category (1). This is one of the several taxonomy problems encountered in this work, as already mentioned, which should be addressed comprehensively by future work.

Table 5. Skills and competences that are necessary to pass successfully through the doctoral studies and for further career (modified from Arenberg Doctoral School, KU Leuven, https://www.kuleuven.be/personeel/competentieprofiel/index_eng.html)

Competence profile of PhD graduates					
Skills mostly useful for an engineering career			**Skills useful for any career**		
(1) Research-related skills	**(2) Academic & technical skills**	**(3) Intellectual skills**	**(4) Leadership & change management**	**(5) Relational skills**	**(6) Self management skills**
PhD-topic specific	Research setup	Conceptual thinking	Leadership & motivation skills	Interpersonal skills / communication	Autonomy
e.g. Constitutive modeling,	Methodological skills and statistical analysis	Analytical thinking	Strategic thinking	Teamwork / working together	Goal-directedness / Result-driven approach
Continuum mechanics	Data interpretation skills	Synthetic skills	Creativity and innovation	Diplomatic skills	Perseverance
	Reporting skills	Critical thinking	Taking initiative & entrepreneurship	Networking	Coping with stress
General engineering research tools	Project and budget management	Interdisciplinary thinking / broadmindedness	Flexibility	Presentations/ speaking in public	Planning, organizing and prioritizing
e.g. Numerical analysis,	Fund raising	Learning capability and interest	International focus	Confidence and assertiveness	Acting and thinking pragmatically
Fundamental data structures in computer science	Pedagogical skills				Problem-solving skills
	Language skills				
	Knowledge of the research field				

The contents of columns (2) through (6) in Table 5 can be read both as skills and, for the majority of them, as seminar topics. It should be reiterated that while some seminars are designed to teach some skills, others focus on helping PhD students to become aware of skills developed by engaging in the activities related to their PhD studies. The respondents of the questionnaire were asked about courses/seminars offered in their institution, their personal opinions on course requirements and questions inquiring their potential involvement with group work; some of these latter questions are not included in Table 6.

Table 6. Survey questions on courses/seminars for PhD students.

A1. Does your university require courses/seminars for PhD students? A2. If yes, of what kind? *
B1. Would you like your students to take courses during their PhD studies? *Please give your personal opinion. In other words, answer this question independently of whether your institution requires courses/seminars or not.* B2. If yes, of what kind? *
C. What seminars do you see relevant/appropriate to be developed or adapted from existing modules as part of Group C activities?

* *Please refer to attached table with the 6 categories of possible course/seminars. Please list additional seminar topics if appropriate.*

4.1.2 Answers to the questionnaire

The 11 answers received from 10 universities are summarized in Table 7. Coursework is a requirement for PhD studies in all 10 institutions. These requirements, however, consist only of research-related courses in three institutions, while two of the three respondents (Bratislava, Pisa) do not see a need for skills training seminars. In most institutions where skills-related training is offered, respondents acknowledge the need for this training, with a couple exceptions (Cardiff, Prague) where less or no training is favored. One respondent remarked that seminars should be enabling students to better perform their research tasks; students should not spend a lot of time learning about research instead of doing research. The majority of the respondents (9 out of 11) believe that courses on research-related skills (category 1) are necessary, while a smaller majority (7 out of 11) also believe that courses/seminars on academic-technical skills (category 2) should be offered. The category of academic-technical skills was also deemed by the majority of respondents to be the most suitable for collaborative seminar development.

In retrospect, question A1 in Table 6 should have been phrased as “does your university require or offer courses/seminars for PhD students?” to distinguish institutions such as KU Leuven (Section 3.2.2), where skills training is offered but not required. Additional responses would have perhaps been submitted, if the question was more broadly phrased. Nevertheless, the survey added some interesting information on skills training courses as described below.

At the Helsinki University of Technology, out of the 60 European Credit Transfer System (ECTS) credits required for a PhD degree, 5 to 15 must belong in the category of Scientific Practices and Principles, which includes topics such as Research methodology, Research ethics and the History and philosophy of science. It is important to note that courses in this category are specifically developed for each faculty, since they differ according to the needs of various research fields.

Table 7. Responses to questions on courses/seminars for PhD students from faculty members in Departments of Civil Engineering.

University	University course requirements		Personal opinion on course requirements		Group C focus
	Yes-No	what kind?	Yes-No	what kind?	
U. of Pisa	Yes	1	Yes	1	1
Czech Technical U., Prague	Yes	1,2,4,5	No, except	foreign languages	
Slovak U. of Technology, Bratislava	Yes	1	Yes	1	2,3
Helsinki U. of Technology	Yes	1,2,4,5	Yes	1,2 (mainly) 3,4,5 (MSc as well)	1,2,4,5
U. College, Dublin	Yes	1,2,3	Yes	1,2,3,6	2,5,6
Technical U., Ostrava	Yes	1,2,5,6	Yes	1,2,5,6	2,4,5,6
Aristotle U. of Thessaloniki	Yes	1,2 (3,4)	Yes	1,2,3,4	2,3,4,5,6
	Yes	1,2 (5,6)	Yes	1,2 (5,6)	2,6
National Technical U. of Athens	Yes	1	Yes	1,2 (mainly) 5	2,5
Cardiff U.	Yes	1,2,6 (mainly) 3,4,5 (some)	Yes	1,2 (mainly) 3,6 (some)	
Heriot-Watt U., Edinburgh	Yes	1,2	-	-	-

Note: 1 = Research-related skills, 2 = Academic & technical skills, 3 = Intellectual skills 4 = Leadership & change management, 5 = Relational skills, 6 = Self management skills

In similar spirit, the Civil Engineering Department at the Aristotle University of Thessaloniki (AUTH) has developed two semester-long courses, "Numerical Methods for Civil Engineers" and "Introduction to Research Methodology", which are required for all PhD candidates. The latter course covers topics such as research setup, methodological skills and statistical analysis, literature searches, teamwork, presentations/speaking in public, planning, organizing and prioritizing. It should be clarified that the number of categories listed in Table 7 is not indicative of the number of courses offered. As an example, the numerical methods course of AUTH falls in category (1), whereas the research methodology course includes elements in categories (2,3,4) or (2,5,6), according to each of the two respondents from this institution. The discrepancy between these two descriptions for the same course underscores the difficulty in creating a transparent taxonomy to describe transferable skills.

Lastly, to the question about collaborative seminar development, respondents found the category of academic-technical skills (category 2) to be the most appropriate, as already mentioned, followed by the category of relational skills (category 5) and self management skills (category 6). Specific skills and seminar topics worth being developed, according to the respondents, include: in category (2), Methodological skills, Data interpretation skills, Pedagogical skills, Research setup, Scientific Integrity, Terminology Principles, in category (4), Creativity and innovation, Taking initiative & entrepreneurship, in category (5), Presentations/speaking in public, Interpersonal skills, Teamwork, and in category (6): Planning, organizing and prioritizing, Problem-solving skills.

4.1.3 Some anecdotal evidence

During the workshop held by the group at KU Leuven in March 2009, two senior engineering PhD students shared their experiences with skills training seminars. They both found the seminars they had attended very interesting and helpful. In addition, they stressed that they liked the fact that the seminars were not required, but it was up to them to select seminar topics and decide on the frequency of seminar attendance.

From the responses to the questionnaire and discussions at the Leuven meeting, it appears that many (perhaps most?) faculty members in universities offering skills training are not very familiar with the training program as a whole, or with individual seminars. This lack of familiarity may be a result of the recentness of these programs or of a perception that these courses do not belong in the PhD curriculum. It remains to be seen whether this lack of familiarity will diminish with time.

4.2 The industry perspective

The EUA completed recently an extensive project on collaborative doctoral education, searching for ways in which the industry can become more directly involved with PhD studies and also become more satisfied with the outcome (EUA, 2009). As part of this project, the opinions of the industry on the development of transferable skills were explored. Survey results show that industry values above all technical strength: on a scale of importance from 0 to 5, technical proficiency was rated most important, with more than 4.5. The next most important attribute was also technical: working in depth at the frontiers of knowledge was rated with 4. At the same time, several transferable skills got a high rating, between 3.5 and 4. These are listed next after their respective categories: category (3), working across disciplines, category (4) originality and creativity and category (5), team player and communicating to non specialists.

In the eyes of the industry, a meaningful taxonomy differentiates between research-oriented activities and business-oriented activities. It is interesting to note that industry considers that communication to non-specialists belongs in the latter category (business). When analyzed by company size, industry responses reveal an important discrepancy between large research and development (R&D) companies and small and medium enterprises (SMEs). The R&D companies have the resources to train their own employees and hence do not find transferable skills an absolute requirement. However, these skills are very important for the SMEs, where PhDs can assume faster a position of responsibility.

4.3 Summary

Section 4 synthesized opinions, of civil engineering faculty, civil engineering PhD candidates and the industry, on the importance and desirability of transferable skills of PhD graduates. The small, opportunity sample of PhD candidates gave an unconditional positive assessment for skills training. On the other hand, survey respondents from civil engineering faculty and the industry are not unanimous in their views, but for different reasons. Faculty members are concerned that PhD candidates may devote too much time on activities peripheral to their research; this concern implies that transferable skills are not that important. However, faculty members are not very familiar with skills training programs, which are fairly recent in most universities, so it is conceivable that their appreciation of skills training may increase with time. To the contrary, industry clearly considers transferable skills to be important. However, to the large R&D companies, which have the means of providing skills training to their employees, transferable skills are desirable but not required. A point of convergence between industry and academia is that communication skills are viewed as the most important category of transferable skills.

5. TWO SEMINARS FOR SKILLS TRAINING

This section provides background on two short seminars for PhD candidates, which can be delivered after suitable customization in civil engineering departments. Seminar materials are available at the website of Group C and listed in Table A1 in the Appendix.

5.1 Seminar adapted: Scientific Integrity

5.1.1 Origin of seminar

The Commission of Scientific Integrity of KU Leuven (http://www.kuleuven.be/cwi/english/index.html) took the initiative to develop a seminar on Scientific Integrity for the skills training program of the Arenberg Doctoral School for the faculties of Science, Engineering and Technology. During the workshop held by Group C at KU Leuven in March 2009, the coordinator of the seminar, Chemistry Professor Arnout Ceulemans, gave a presentation on the development and delivery of the seminar, which was followed by a stimulating discussion among workshop participants. Responding to the interest expressed by Group C members, Prof. Ceulemans agreed to make available the material of the seminar, which is posted at the website of Group C (see Table A1 in Appendix).

5.1.2 Contents of seminar

The two-hour seminar consists of four parts, each presented by a different instructor: (1) an overview of the seminar, (2) the ethics perspective on scientific integrity, (3) the law perspective on scientific integrity, with an emphasis on copyright law and (4) an introduction on the role of the Commission on Scientific Integrity of KU Leuven and the resources it offers to the research community on campus. With this background, participants discuss a case study: in the 2008-2009 seminar, the case discussed was the retraction of two biochemistry papers with results that could not be replicated, based on an article published in the scientific journal Nature.

The goal of the seminar is stated as “to raise awareness of the importance of integrity for a professional attitude in research”. This goal is quite broad and, hence, seminar material can easily serve as a base for the development of a seminar on Scientific Integrity at other institutions. Seminar material includes a rich list of national and international resources. One resource of particular interest is the policy briefing by the European Science Foundation titled “Good scientific practices in research and scholarship”. Customizing seminar material will entail adding local (specific to the institution, if available) and national resources, as well as locating research misconduct cases concerning civil engineering topics.

5.2 Seminar developed: Terminology Resources & Principles

5.2.1 Aim of seminar development

As mentioned in Section 3, skills training seminars are offered to students from many different disciplines and, hence, do not provide tight links to the subject area of each participant. This loose fit between skills training content and each participant's background provided the motivation to develop, as a pilot, a seminar on Terminology that draws examples mostly from engineering, with particular focus on civil engineering.

The ultimate goal of developing a seminar on Terminology was to provide a model for collaborations between experts in a thematic field and civil engineering faculty. Such collaborations are necessary for the production of seminars tailored to civil engineering PhD candidates. It is hoped that seminar material can serve as prototype for seminars developed by future collaborations between civil engineering faculty and thematic field experts. For this reason, the key aspects of seminar development are discussed in detail in this section.

The seminar was developed by a faculty member of a Civil Engineering School (the author of this report) and the President of the Hellenic Society for Terminology, as described by Pantazidou and Valeontis (2009). Terminology was selected as a topic mainly because of the opportune securing of the contribution of an expert in this thematic field. Moreover, Terminology belongs in the "Academic & Technical skills" category, deemed most appropriate for collaborative seminar development by group members.

Seminar material was compiled with the aim that it be used by engineering faculty members sensitized to terminology needs in research. The seminar material is meant to enable an engineering instructor to deliver the seminar to a group of engineering PhD candidates after devoting a couple of days to become familiar with basic issues in Terminology and customize the material to the audience of the seminar.

5.2.2 Major considerations for seminar development

Three overarching requirements guided the development of the material for the seminar, for an envisioned audience of postgraduate students in civil engineering, mainly PhD candidates.

Firstly, the material produced should make an engineering faculty member with no formal background in Terminology feel comfortable delivering the seminar. To achieve this, seminar material must be grounded firmly to engineering and offer opportunities for further customization to the subfield of the instructor.

Secondly, the seminar should conform to good educational practices. Accordingly, learning objectives are stated explicitly and the delivery format is such that encourages students to participate actively.

When establishing learning objectives, it is important to cover a wide range of student performance. In other words, it is important to have a basic subset of requirements, which is considered to be the minimum for successful completion of a module, to which elements of better performance are added, gradually, all the way to top performance. For an introductory module, such as this seminar on Terminology, it is important to include awareness of the Terminology field itself and of available resources, together with specific tasks that participants will be able to carry out after the completion of the seminar.

The overall goal of the seminar is described as enabling the participants to make informed choices of technical terms. To this end, the seminar introduces students to terminology principles and familiarizes them with sources of organized glossaries. In terms of specific outcomes, at the end of seminar, participants:

1. know of national standards body & source of standards and can get in contact with the national society for terminology, if it exists;
2. can locate terminology standards and glossaries in their subject area;
3. can use web-based multilingual term resources;
4. are familiar with good practices in definition-giving and term-rendering, and
5. are able to evaluate technical terms on the basis of terminology principles.

Outcomes 1, 2 and 3, which form the basic subset of requirements, are easily accomplished since they are mostly informational and amply covered by the seminar supplementary material. The success of outcomes 4 and 5 depends on the richness of the discussion of the examples of the seminar.

Thirdly, when teaching PhD candidates, one should take into account that they are well on their way of becoming autonomous learners. Consequently, the seminar includes open-ended assessment activities, which correspond to the stated objectives and require the active involvement of the seminar participants. In addition, it offers opportunities and resources for students to get more involved with Terminology, after the completion of the seminar, on their own initiative. It is important that all examples in the seminar are drawn from a variety of civil engineering sub-disciplines, so that seminar participants recognize the relevance of Terminology to their own work.

The scepticism of some faculty members towards skills training was discussed in Section 4. Convincing faculty members of the existence of Terminology needs is, hence, the first critical junction for a proposal of a seminar on Terminology. Then, during seminar delivery, the biggest challenge is to help PhD candidates realize that Terminology is, essentially, a research tool. It is difficult to overcome these two obstacles without giving examples from the thematic area of the audience. For this purpose, considerable effort in creating the seminar material was devoted to development of civil engineering examples, in consultation with EUCEET partners and civil engineering colleagues of the author of this report.

One example from the seminar material is left on purpose as an open-ended question, in order to stress the fact that serious terminology uncertainties are often overlooked. Every engineer with a minimum tendency for organized thought and expression will agree that different terms should be used to convey different meanings. In engineering, nevertheless, it is customary that almost no distinction is made among the following terms (listed alphabetically): coefficient, constant, factor, index, parameter. A seminar on Terminology will be useful in every engineering school where the interchangeable use of the aforementioned terms is the case: the "theory kernel" of the seminar (see next section) is meant to, at a minimum, help participants first become aware and then question habits of loose use of terms. Although complete differentiation of such terms may not be possible or even desirable, investigating different shades of meaning of seemingly similar terms offers a deeper appreciation of the subject field where these terms are being used.

5.2.3 Seminar structure & contents

The seminar consists of a 2-hour presentation on day 1, during which an assignment is handed, due on day 15. The seminar concludes with a 1-hour discussion on day 22, after the instructor has read the assignments and is in a position to guide the discussion accordingly.

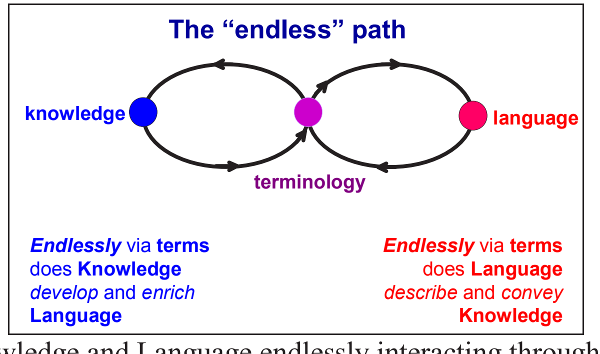

Figure 1. Knowledge and Language endlessly interacting through Terminology. (From: Website of Hellenic Society for Terminology: http://www.eleto.gr/en/TheEndlessPath.htm.)

As mentioned, the instructor needs above all to establish the relevance of the seminar. The first slide of the presentation, shown as Figure 1, is an attempt to bring the terminology of a domain from the periphery to its core, by depicting terminology as the interface between knowledge and language. The relationship of knowledge to language was first addressed by the philosopher Plato, in the dialogue Cratylus. Figure 1 is, understandably, a simplified version of this relationship, aiming at inviting seminar participants to gradually build their own version, possibly different, possibly more complex.

Practicing good terminology habits, it is recommended that the instructor then give the two definitions of terminology, as “set of designations belonging to one special language” (i.e. subject field) (ISO 1087) and “scientific discipline dealing with concepts and their representations in special languages” (Schmitz, 2006). It is important to stress during the seminar that terminology is approached from the perspective of standardization of technical terms. For a broader view, the interested seminar participant is referred to Cabré (2003).

Next, practicing good teaching habits, the instructor spells out the learning objectives of the seminar, discussed in the previous section. It is important that these are communicated explicitly, since their role is essentially that of a contract between the instructor and the participants.

The introduction goes on then to describe the format and content of the seminar, so that the participants know what to expect. For the same purpose, i.e. so that participants know exactly where they are heading, the introduction closes with the summary of the entire presentation, which states that informed choices of terms are made when:

- concepts corresponding to terms are fully specified by providing for each concept a definition and determining its position in a concept system;
- existing glossaries of technical terms are consulted;
- principles for term rendering are observed.

In the second and most important part of the presentation, the instructor has to establish the typical terminology needs that arise in research. In general, most researchers lack a systematic way to (1) approach an unknown term, (2) name an established concept, (3) name a new concept and (4) render a term from another language. These four needs are discussed with the help of several civil engineering examples drawn from the thematic fields of fluid flow, structures, geotechnical engineering and geoenvironmental engineering. Clearly, the previously mentioned choice among coefficient, constant, factor, index and parameter is a problem of naming an established concept.

The third part of the presentation is the “theory kernel” of the seminar: herein terminology basics are presented as tools that address the needs described in the previous part of the seminar. First, the main players of terminology, namely **object**, **concept** and **term**, are differentiated. Here it is important that the instructor stress that, in Terminology, an object is anything perceivable or conceivable. Second, the triptych **concepts** – **concept relations** – **concept systems** is introduced. The message here is that the position of concept in a concept system, which depicts relations among concepts, together with its definition help in anchoring the concept in the subject field. Illustrative examples include a concept system from contaminant hydrology. Another concept system shows bridges categorized according to different criteria (e.g. use, material, load transfer mechanism). To keep the theoretical part light, the presentation includes only one slide with guidelines on definition giving, with information abstracted from the international standard on principles and methods of terminology work (ISO 704). This is a good opportunity for the instructor to stress that a definition defines a concept and not a term, so that students be reminded of the often overlooked difference between the two. The theory part of the seminar closes with the desired attributes of a term (ISO 704), since the highest level of performance expected by the participants of the seminar is to evaluate existing terms.

The next and last part of the seminar provides opportunities to apply the presented terminology basics on the evaluation of terms appearing in real texts. Good candidate texts are newspaper articles on engineering topics or technical documents translated by non specialists. It helps if the texts are presented in two languages (a source language, often English, and a target language), because it is easier to spot weak terms in texts translated by non specialists, especially if produced in a hurry or in great volumes and, hence, with somewhat reduced care (e.g. newspaper articles, European regulations). Another possibility is to locate two texts that use different terms for the same concept. In essence, the instructor needs texts with slightly questionable usage of terms; suggestions for sources of suitable texts are included in seminar material (see next section and Table A1 in the Appendix). The slide presentation includes an excerpt from a 2007 article on a theory for the collapse of the World Trade Center, which was published in a Greek newspaper using information from an article by the British Broadcasting Corporation. The instructor invites seminar participants to identify, in the Greek version of the excerpt, any terms that need to be discussed, clarifying that this last part of the seminar is similar to the assignment students will have to hand in.

For the assignment, the students are given a couple excerpts with highlighted terms and asked to:

- search for and evaluate definitions of the corresponding concepts;
- evaluate terms in own language;
- use suggested resources for the evaluation and search for additional ones.

To acknowledge (and benefit from) the autonomy exhibited by many PhD candidates, it is recommended that participants be given the option to work either with the text(s) given in the assignment or with a comparable text located by themselves, which matches more closely their interests.

5.2.4 Educational materials produced

The backbone of the seminar is a PowerPoint presentation, available in English and Greek. The PowerPoint presentation is accompanied by a text (in English), which provides a conversational commentary for each slide and many cues to engage participants in the discussion. The presentation is clearly divided in the parts described in Section 5.2.3 and, hence, together with the text, they make a detailed lesson plan.

In addition, seminar material includes information on Terminology Societies in various European countries, International Institutes and Committees for Terminology, as well as advice on search strategies for relevant international standards. It is reiterated that the instructor must be supplied with contact points and highly selected background material, which is meant to simulate, with a reasonable effort on the instructor's part, the customary conditions of the teacher-expert most university professors have become accustomed to and cannot do without. It is believed that this additional material is an absolute requirement for making seminar material transferable.

Finally, seminar material includes suggestions of suitable multilingual texts. It is anticipated that the most time-consuming task on the part of the instructor is customizing the discussion of excerpts from real texts to his or her field of expertise. Customization includes locating suitable texts, identifying terms that provide opportunities for a rich discussion, and performing a background analysis for these terms. The analysis consists of identifying a definition compatible with guidelines discussed, locating alternative terms in the target language, and evaluating them according to the discussed attributes of a good term.

5.3 Future work

5.3.1 Checking the transferability claim

The underlying premise of Section 5 is that it is possible to develop seminar material following the "textbook tradition". In other words, it is believed that, with the proper preparation, seminar material can be self-contained, as textbooks are, and used by different instructors. The two seminars described in the previous sections must be delivered in a few institutions, in order to check the transferability claim. Experiences from exchanging seminar material will be necessary for making clarifications and modifications, as well as adding new material, in order to ensure that seminar material is indeed transferable.

5.3.2 Dissemination

Collaborative development of seminar material on the skills and competences discussed in Section 3 requires habits of cooperation that are not customary across disciplines perceived as dissimilar (e.g. humanities and engineering). For the development of collaborations across disciplines, dissemination efforts should reach beyond civil engineering boundaries, to the disciplines that systematically study topics appearing in Tables 2 and 3 (e.g.

Information literacy, Communication to the public, Research ethics). For such a collaboration to be fruitful, the two sides must meet somewhere in between. To give an example for terminology, the civil engineering instructor must be willing to learn a little bit about terminology and “bug” his/her colleagues for the development of customized examples, while at the same time the terminology expert must be willing to sacrifice completeness and be able to converse with a non specialist. The role of the terminology expert is to provide guidance on terminology issues, while subject-matter experts are necessary to create examples specific to an engineering discipline.

6. CONCLUSIONS

Doctoral studies remain to a high degree the product of a relationship between an individual student and a supervisor, despite all changes to doctoral education, advocated or applied. At the same time, it is widely recognized that PhD programs need some structure in order to achieve their two distinct goals: producing research output and providing research training.

Structure can be provided to doctoral programs through either their administration or through coursework offered to doctoral students. Review of doctoral education practices in Europe and the US showed that the organizational structure of PhD studies and the training offered are inter-related. Larger administrative units, such as doctoral schools, can pool resources to offer both thematic training and training on transferable skills.

The development of transferable skills aims at enabling better performance in research and improving employability prospects for a variety of career paths beyond the PhD. The term “transferable skills training” seems to have become the norm in Europe, whereas “professional development” is the more prevalent term in the US. Partly in agreement with the terminology used, in Europe, the development of transferable skills is considered to be a responsibility of the doctoral school, or at least an activity organized at the doctoral school level. On the contrary, in the US, professional development is most often delegated to career services.

Several European universities offer skills development training. Organizing such courses through graduate schools, as opposed to career services, may result in assembling the assessment data that are necessary for evaluating what these seminars can achieve. Skills development programs are recent, so, understandably, such data are still missing.

Skills training can be improved further if tailored to its audience. However, skills training requires considerable resources and, naturally, universities cannot afford creating seminars customized to the PhD candidates of each department. Interdisciplinary teams can best address this need, ideally within international networks that can provide a framework for collaborations between thematic field specialists and civil engineering faculty.

The seminar on Terminology described herein aims at serving as a prototype of brief, intensive seminars customized to audiences of PhD candidates in civil engineering, so that participants make the most out of the seminars, while devoting to them minimal time. Customized seminars may also help faculty members appreciate the relevance and the usefulness of skills training.

The development of the seminar on Terminology also aims at providing a model for collaborative production of transferable educational materials. This model helps with economizing resources, since the materials produced can then be used across civil engineering departments by civil engineering instructors other than those who developed them. It is believed that transferability is possible only if contents are specific to civil engineering, and provided that seminar material includes resources for further adaptation of the contents to the background of the instructor and the audience. This transferability claim needs to be supported through future exchanges of such material.

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APPENDIX

A complete record of work performed within Group C and of its products can be found in the group's website (http://www.euceet.eu/workgroups/c/index.php?id=78), by selecting the link "Administration", for the internal documents used for group work (including the list of group members, minutes from meeting and presentations on group work), or the link "Work Products", for the materials produced or assembled by Group C. Table A1 provides a list of work products and of the main documents guiding group work.

Table A1. Main traces of Group C work.

Material produced by Group C
Seminar for PhD candidates in civil engineering on "Terminology Resources and Principles" • PowerPoint presentation (EN, EL) • Slide by slide commentary of PowerPoint presentation • Terminology resources • Sources of texts to be used in seminar • A conference article describing seminar development, with extended abstract in Greek
Material assembled by Group C
Seminar for PhD candidates in science and engineering on "Scientific Integrity", developed at KU Leuven (PowerPoint presentations) • Background of Scientific Integrity Training at KU Leuven, A. Ceulemans • Scientific Integrity – Introduction, P. Van Houtte • Ethics and Scientific Integrity, M. Meganck • Copyright Law & Scientific Integrity, M.-C. Janssens • The Commission on Scientific Integrity @ KU Leuven, I. Lerouge
Internal documents guiding Group C work (selection)
• Minutes from October 2008 meeting, Warsaw Technical University • Questionnaire on skills training • Minutes from March 2009 workshop, KU Leuven

THEME E: Implementation of the framework for qualifications in civil engineering based on learning outcomes and competences

Report of the
Working Group

THEME E: IMPLEMENTATION OF THE FRAMEWORK FOR QUALIFICATIONS OF A CIVIL ENGINEER BASED ON LEARNING OUTCOMES AND COMPETENCES

Report of Working Group
Laurie F. BOSWELL[1], Marina Pantazidou[2], Doina Verdes[3], Bernard Le Tallec[4]

1. INTRODUCTION

This report is written mainly for an audience of members of departments of faculties of civil engineering, who may be at different stages of familiarity with the concept of outcome-based courses and curricula, or in general outcome-oriented education. Some readers are mostly familiar with content-based structuring of a course or a curriculum (type 1 audience). Others may be aware of existing outcome-based frameworks of qualifications, which are implemented either for the purposes of accreditation or for quality/accountability purposes (type 2 audience). Yet others may have gone through the exercise of structuring or restructuring courses and curricula at their universities following the guidelines of a specific framework, as a result of an imposed university-wide practice or out of their own initiative (type 3 audience). Finally, some readers may have gone through the exercise of demonstrating that a curriculum designed to satisfy a particular framework of qualifications indeed produces these intended outcomes (type 4 audience).

Appendix 1 is a summary of a questionnaire given to delegates at the 2nd General Assembly of the Thematic Network in Warsaw, October 2008. It can be seen from the distribution of answers to questions 1 and 2 that most of respondents are familiar with outcome-based education (OBE) and that European universities have encouraged its adoption to Civil Engineering Programs.

Given the variety in audiences, this section provides a brief overview on outcome-based education, starting with the relevant definitions. The following four sections present existing frameworks of qualifications (Section 2: EUR-

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ACE, Section 3: ASCE, Section 4: EUCEET, Section 5: Tuning). Finally, Section 6 provides examples of good practices at university level (UK, Romania), program-level (France) or course-level (Greece). It should be stressed early on, addressing type 1 audience in particular, that content-driven and outcome-driven approaches are not conflicting but complementary. Following the one or the other approach does not lead to better or, necessarily, different results. However, an outcome-driven approach makes it easier for instructors to explain what they have achieved by teaching a course.

1.1 Term definitions

The OBE model, as proposed by Spady [1], is showed in figure 1. This figure is complemented with the following definitions.

Learning objective is a detailed description that states the expected change in student learning, how the change will be demonstrated and the expected level of change [2].

Learning outcome refers to the knowledge, skill or behaviour that is gained by a learner after instruction is completed and may include the acquisition, retention, application, transfer, or adaptability of knowledge and skills [2].

Outcome-based education (OBE) is education based on learning experiences designed to meet specific learning outcomes and competences. Finally, in this report, the term *framework* refers to a two-dimensional matrix defined by a vertical axis that lists the desired competences and skills (outcomes) and a horizontal axis that specifies the desired level of achievement for each outcome.

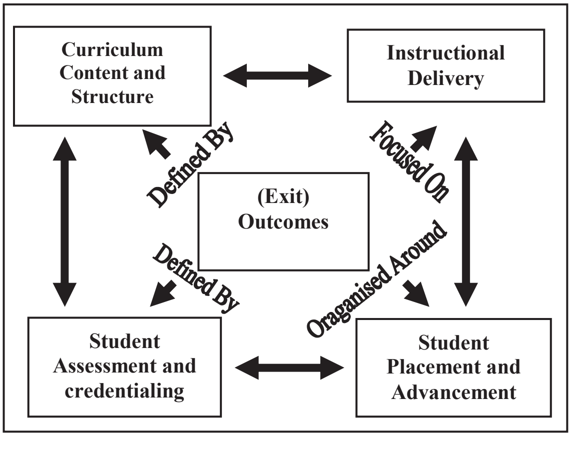

Figure 1. The OBE model - after [1]

The desired level can be described either on a numerical scale (e.g., Tuning) or qualitatively (e.g., ASCE).

1.2. Scales of OBE approaches

Outcome-based education is suitable at any scale. It can be applied at a course level to tailor assignments and assessment to specific learning outcomes and objectives. By defining objectives and outcomes, OBE plays the role of some sort of contract between students and the instructor, a contract that is more transparent than a list of topics to be covered in a course. At the other end of the scale, a whole program can be designed so that it corresponds to broad competences and skills of the program's graduates. The program can be an integrated undergraduate program, a two-cycle program or a separate masters program. In the case of two-cycle programs, the structure of the framework (as defined above) can be the same, with differences in the desired level of achievement on the horizontal axis.

1.3. Reasons for adopting OBE

The motivations for adopting an outcome-based approach are of different kinds. In some countries (e.g., UK) it is a legal requirement both at a course and program level. Such legislation is prompted primarily to fulfill the accountability obligation of educational institutions. On the other hand, outcome-based education is better suited to produce market-relevant degrees or, in general, address the needs of the society. Other times, OBE is adopted because the industry demands it. Finally, OBE is sometimes adopted by individual instructors as they become familiar with literature on instruction and cognition.

1.4. Advantages and drawbacks of OBE

The most obvious advantage of OBE is the clarity of the end goals of education. In addition, it enables the development of defendable links between education outcomes and program accreditation. What is more, it promotes a close relationship between outcomes of individual courses and of the entire program. This close relationship makes possible the emphasis on horizontal skills, such as modeling or design, which can be developed in a series of courses and at different levels in each tier of two-cycle programs.

At the same time, OBE approaches may become too prescriptive. Some instructors may feel that the OBE structure is an imposition on their freedom to design and deliver a course. Another problem is that because an outcome-based curriculum is not as unambiguously defined as a content-driven one, an OBE curriculum may, in fact, be outcome-driven on paper only. This is possible if existing course contents are mapped to or forced into framework components. In this case, a content-driven curriculum is newly baptized as an OBE curriculum, but without instituting any changes in educational philosophy, only changes in procedures.

1.5. Activities complementary to OBE

It would be a mistake to imply that a desired set of competences can only be achieved through an outcome-based curriculum. Profession-oriented skills can be achieved through practical training of students, which, however, presupposes a suitable administrative structure some universities lack. In addition, profession-oriented skills can be fully developed at the desired level through a training period of graduates (as envisioned in the ASCE framework).

1.6. Responses from the EUCEET OBE Questionnaire

Once more reference will be made to Appendix I and in particular for the answers to questions 3 and 4. No attempt will be given to reproduce individual answers, but strong themes have emerged to give substance to the subsections, in Section 1. The respondents considered the overwhelming disadvantage of OBE is that it is considered to be too specialized, and descriptive, which results in a rigid course structure.

Statements might look like OBE, but are they in practice, and how can then be judged? They should be applicable to the design, delivery, support and assessment of programs. There is a lack of student involvement and a considerable work effort is required to transform existing programs into OBE equivalents.

Amongst the most advantages, the respondents considered that OBE promotes discussions about contents, teaching methods, assessment, and clarifies what is needed to know. Thus required skills and competencies are defined; OBE is ideal for Life Long Learning with no strict time scale and for programs which may be designed for industry and special branches of engineering.

OBE is independent of the level of input and it is easy to demonstrate that this level has been achieved. An OBE approach indorses a label of quality. All UK/spec compliant Programs are examples of good OBE practice. There are also examples of university civil engineering programs, which employ the principle of OBE, throughout a good deal of Europe. Good practice can be seen at individual and Faculties levels.

2. EUR-ACE FRAMEWORK STANDARDS FOR THE ACCREDITATION FOR ENGINEERING PROGRAMS

EUR-ACE is the first of the four existing frameworks of qualifications to be considered into this report. In its current form the content of EUR-ACE are applicable to general engineering education therefore it is not difficult to extend this application to Civil Engineering programmes [5]. An objective of the report is to develop links between the content of EUR-ACE and the other existing frame works of qualifications towards recommendations which are specific to Civil Engineering education.

The six Programs Outcomes of accredited engineering degree programs are:

- Knowledge and Understanding;
- Engineering Analysis;
- Engineering Design;
- Investigations;
- Engineering Practice;
- Transferable Skills.

2.1 Knowledge and Understanding

The underpinning knowledge and understanding of science, mathematics and engineering fundamentals are essential to satisfying the other programme outcomes. Graduates should demonstrate their knowledge and understanding of their engineering specialisation, and also of the wider context of engineering.

2.2 Engineering Analysis

First Cycle graduates should have: the ability to apply their knowledge and understanding to identify, formulate and solve engineering problems using established methods; the ability to apply their knowledge and understanding to analyse engineering products, processes and methods; the ability to select and apply relevant analytic and modeling methods.

Second Cycle graduates should have: the ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications; the ability to formulate and solve problems in new and emerging areas of their specialisation; the ability to use their knowledge and understanding to conceptualise engineering models, systems and processes; the ability to apply innovative methods in problem solving.

2.3 Engineering Design

Graduates should be able to realise engineering designs consistent with their level of knowledge and understanding, working in cooperation with engineers and non-engineers. The designs may be of devices, processes, methods or artefacts, and the specifications could be wider than technical, including an awareness of societal, health and safety, environmental and commercial considerations.

2.4. Investigations

Graduates should be able to use appropriate methods to pursue research or other detailed investigations of technical issues consistent with their level of knowledge and understanding. Investigations may involve literature searches, the design and execution of experiments, the interpretation of data, and computer simulation. They may require that data bases, codes of practice and safety regulations are consulted.

2.5. Engineering Practice

Graduates should be able to apply their knowledge and understanding to developing practical skills for: solving problems, conducting investigations, and designing engineering devices and processes. These skills may include the knowledge, use and limitations of materials, computer modeling, engineering processes, equipment, workshop practice, and technical literature and information sources. They should also recognise the wider, non-technical implications of engineering practice, ethical, environmental, commercial and industrial.

2.6. Transferable Skills

The transferable skills are the skills necessary for the practice of engineering, and which are applicable more widely; these should be developed within the programme.

3. CIVIL ENGINEERING BODY OF KNOWLEDGE FOR THE 21st CENTURY

The American Society of Civil Engineering have produced a document entitled "Civil Engineering Body of Knowledge for the 21st Century" [4]. This comprehensive document addresses the necessary educational response to the essential changes what are expected to occur in the practice of Civil Engineering in the 21st Century.

Of particular relevance to this report is Figure 2, (Figure ES-1 in the original document) to Body of Knowledge (BOK) will be fulfils by mean of toward education an experience through the 1st and 2nd cycle process, the role of the two cycles is shown in the Figure. In attempt to compare the BOK to EUR-ACE, Table 1 which has been reproduced by BOK shows the 24 BOK outcomes. These are more detailed that the EUR-ACE outcomes of section 2. However the essential details of the OBE approach have been maintained in both frameworks.

Outcome Number and Title	Level of achievement					
	1	2	3	4	5	6
	Know-ledge	Compre hension	Applic ation	Analy sis	Synthes is	Evalua-tion
1. Mathematics	**B**	**B**	**B**			
2. Natural Sciences	**B**	**B**	**B**			
3. Humanities	**B**	**B**	**B**			
4. Social Sciences	**B**	**B**	**B**			
Technical						
5. Material sciences	**B**	**B**	**B**			
6. Mechanics	**B**	**B**	**B**	**B**		
7. Experiments	**B**	**B**	**B**	**B**	**M/30**	
8. Problem recognition and solving	**B**	**B**	**B**	**M/30**		
9. Design	**B**	**B**	**B**	**B**	**B**	**E**
10. Sustainability	**B**	**B**	**B**	**E**		
11. Contemp. Issues &hist. perspectives	**B**	**B**	**B**	**E**		
12. Risk and uncertainly	**B**	**B**	**B**	**E**		
13. Project management	**B**	**B**	**B**	**E**		
14. Breath in civil engineering areas	**B**	**B**	**B**	**B**		
15. Technical specialization	**B**	**M/30**	**M/30**	**M/30**	**M/30**	**E**
Professional						
16.Communications	**B**	**B**	**B**	**B**	**E**	
17. Public policy	**B**	**B**	**E**			
18. Business and publics administration	**B**	**B**	**E**			
19. Globalisation	**B**	**B**	**B**	**E**		
20. Leadership	**B**	**B**	**B**	**E**		
21. Team work	**B**	**B**	**B**	**E**		
22. Attitudes	**B**	**B**	**E**			
23. Life long learning	**B**	**B**	**B**	**E**	**E**	
24. Professional and Ethical responsibility	**B**	**B**	**B**	**B**	**E**	**E**

Key:		
	B	Portion of the BOK fulfilled through the bachelors degree
	M/30	Portion of the BOK fulfilled through the master's degree equivalent (approximatively 30 semester credits of acceptable graduate-level or upper-level undergraduate courses in a specialized technical area and/or professional practice area related to civil engineering)
	E	Portion of the BOK fulfilled trough the prelicensure Experience

Figure 2. Entry into the practice of civil engineering at the professional level requires fulfilling 24 outcomes to the appropriate level of achievement [1]

Table 1. Entry into the practice of civil engineering at the professional level requires fulfilling 24 outcomes to the various levels of achievement [4]

Outcome number and title	To enter the practice of civil engineering at the professional level, and individual must be able to demonstrate this level of achievement
Foundation Outcomes	
1 Mathematics	**Solve** problems in mathematics through differential equations and **apply** this knowledge to the solution of engineering problems (I.3)
2 Natural sciences	**Solve** problems in calculus-based physics, chemistry, and one additional area of natural science and **apply** this knowledge to the solution of engineering problems (I.3)
3 Humanities	**Demonstrate** the importance of the humanities in the professional practice of engineering (I.3)
4 Social sciences	**Demonstrate** the incorporation of social sciences knowledge into the professional practice of engineering (I.3)
Technical Outcomes	
5 Material science	Use knowledge of material science to **solve** problems appropriate to civil engineering (I.3)
6 Mechanics	**Analyze** and solve problems in solid and fluid mechanics (I.4)
7 Experiments	**Specify** and experiment to meet a need, conduct the experiment, and analyze and **explain** the resulting data (I.5)
8 Problem recognition and solving	**Formulate** and solve an ill-defined engineering problem appropriate to civil engineering by **selecting** and applying appropriate techniques and tools. (I.4)
9 Design	**Evaluate** the design of a complex system, component, or process and ***assess*** compliance with customary standards of practice, user's and project's needs, and relevant constraints (I.6)
10 Sustainability	**Analyze** systems of engineered works, whether traditional or emergent, for sustainable performance. (I.4)
11 Contemporary issues and historical perspectives	**Analyze** the impact of historical and contemporary issues on the identification, formulation, and solution of engineering problems and **analyze** the impact of engineering solutions on the economy, environment, political landscape, and society (I.4)
12 Risk and uncertainly	**Analyze** the loading and capacity, and the effects of their respective uncertainties, for a well-defined design and **illustrate** the underlying probability of failure (or non-performance) for a specified failure mode. (I.4)
13 Project management	**Formulate** documents to be incorporated into the project plan. (I.4)
14 Breadth in civil engineering areas	**Analyze** and solve well-defined engineering problems in at least four technical areas appropriate to civil engineering. (I.4)
15 Technical specialization	**Evaluate** the design of a complex system or process, or ***evaluate*** the validity of newly created knowledge or technologies in a traditional or emerging advanced specialized technical area appropriate to civil engineering (I.6)

Table 1. continue

Professional Outcomes	
16 Communication	**Plan**, **compose** and **integrate** the verbal, written, virtual, and graphical communication of a project to technical and non-technical audiences. (I.5)
17 Public policy	**Apply** public policy process techniques to simple public policy problems related to civil engineering works. (I.3)
18 Business & public administration	**Apply** business and public administration concepts and processes. (I.3)
19 Globalization	**Analyze** engineering works and services in order to function at a basic level in a global context. (I.4)
20 Leadership	**Organize** and **direct** the efforts of a group. (I.4)
21 Teamwork	**Function** effectively as a member of a multidisciplinary team. (I.4)
22 Attitudes	**Demonstrate** attitudes supportive of the professional practice of civil engineering. (I.3)
23 Lifelong learning	**Plan** and **execute** the acquisition of required expertise appropriate for professional practice. (I.5)
24 Professional and ethical responsibility	**Justify** a solution to an engineering problem based on professional and ethical standards and **assess** personal and ethical development. (I.6)

4. EUCEET (EUROPEAN CIVIL ENGINEERING AND TRAINING)

The EUCEET Thematic network has coordinated several studies during the first and second phases of his existence (EUCEET I and EUCEET II). The current phase, EUCEET III, is examining frameworks of qualifications with particular application in Civil Engineering education.

The study of working group SPI in EUCEET II produced a core curriculum for Civil Engineering, which was agreed by the network members [6]. Table 2 shows a list of 25 subjects which forms recommended core curricula. The list is not exhaustive but contains the most important subjects what should be included in the education of Civil Engineering within the first and second cycle.

The approach adopted by the working group SP1 contained a content-based curriculum and OBE based review methodology. These approaches were complementary and ask attention. Thus a clear framework has been defined within the ECEET Thematic Network.

Table 2

No	CORE SUBJECTS IN CURRICULA FOR CIVIL ENGINEERING	Credits for course:		
		Integrated	Two-tier system	
		10 sem	1st cycle 8 sem	2nd cycle 2 sem
1.	Mathematics and Applied Mathematics	19.0-27.0	13.0-19.0	5.0-7.0
2.	Applied Chemistry	3.0-4.0	2.5-3.5	
3.	Applied Physics	5.5-7.5	4.5-6.5	
4.	Computer Science and Computational Methods in C.E.	7.0-9.0	5.5-7.5	1.5-2.5
5.	Drawing and Descriptive Geometry	4.0-6.0	3.5-4.5	
6.	Mechanics	5.5-7.5	4.5-5.5	1.0
7.	Mechanics of Materials	8.0-11.0	6.5-8.5	1.5-2.5
8.	Structural Mechanics	9.0-13.0	7.0-10.0	1.5-2.5
9.	Fluid Mechanics & Hydraulics	5.0-7.0	4.5-6.5	1.0
10.	Engineering Surveying	4.5-6.5	4.0-6.0	1.0
11.	Building Materials	5.5-7.5	4.5-6.5	1.0
12.	Buildings	3.5-5.5	3.5-4.5	
13.	Basis of Structural Design	3.5-5.5	3.5-5.5	
14.	Engineering Geology	3.5-4.5	3.0-4.0	
15.	Soil Mechanics and Geotechnical Engineering	7.5-10.5	5.5-7.5	1.5-2.5
16.	Structural Concrete	8.0-11.0	6.0-9.0	1.5-2.5
17.	Steel structures	6.5-9.5	5.0-7.0	1.5-2.5
18.	Timber, Masonry and Composite Structures	3.5-5.5	3.0-4.0	
19.	Transportation Infrastructure	3.5-5.5	3.5-4.5	
20.	Urban and Regional Infrastructure	2.5-3.5	2.5-3.5	
21.	Water Structure and Water Management	3.5-5.5	3.0-4.0	
22.	Construction Technology & Organisation	6.0-8.0	4.5-6.5	1.5-2.5
23.	Economics and Management	6.0-9.0	5.0-7.0	1.5-2.5
24.	Environmental Engineering	3.5-5.5	3.5-4.5	
25.	Non-technical subjects	7.5-10.5	5.0-7.0	2.0-4.0
Core subjects total		**175.0**	**140.0**	**30.0**
Specialisation subjects total		**125.0**	**100.0**	**30.0**
Total		**300.0**	**240.0**	**60.0**

5. TUNING - QUESTIONS FOR PROGRAMME DESIGN AND PROGRAMME DELIVERY, MAINTENANCE AND EVALUATION IN THE FRAMEWORK OF THE BOLOGNA REFORM

Both ECEET II and EUCEET III have been involved in the project. An exercise was conducted during EUCEET II to establish the generic and subject specific competences in civil engineering programs. Academic employees and graduates were asked to express their views in respect of set of questions.

Table 3. Generic Competences

Competence number	Shorter label	Descriptor
1.	work in an interdisciplinary team	Ability to work in an interdisciplinary team
2.	diversity and mulficulturality	Appreciation of diversity and multiculturality
3.	knowledge area	Basic knowledge of the field of study
4.	knowledge profession	Basic knowledge of the profession
5.	analysis and synthesis	Capacity for analysis and synthesis
6.	applying knowledge in practice	Capacity for applying knowledge in practice
7.	generating new ideas	Capacity for generating new ideas (creativity)
8.	adapt to new situations	Capacity to adapt to new situations
9.	learn	Capacity to learn
10.	critical abilities	Critical and self-critical abilities
11.	decision-making	Decision-making
12.	computing skills	Elementary computing skills (word processing, database, oth
13.	ethical commitment	Ethical commitment
14.	interpersonal skills	Interpersonal skills
15.	second language	Knowledge of a second language
16.	oral and written communication	Oral and written communication in your native language
17.	research skills	

Table 4. Specific competences

Competence number	Shorter label	Descriptor
1.	To apply knowledge of mathematics	An ability to apply knowledge of mathematics and other basic subjects
2.	The mechanics, applied mechanics	An ability to use knowledge of mechanics, applied mechanics and of other core subjects relevant to civil engineering
3.	To design a system to meet desired needs	An ability to design a system or a component to meet desired needs
4.	To solve common civil engineering problems	An ability to identify, formulate and solve common civil engineering problems
5.	To solve complex civil engineering problems	An ability to identify, formulate and solve complex civil engineering problems
6.	The interaction between technical and environmental	An understanding of the interaction between technical and environmental issues and ability to design and construct environmentally friendly civil engineering works
7.	To design and conduct experiments,	An ability to design and conduct experiments, as well as analyse and interpret data
8.	To identify research needs and necessary resources	An ability to identify research needs and necessary resources
9.	To use the techniques, skills and modem tools	An ability to use the techniques, skills and modern engineering tools, including IT, necessary for engineering practice
10.	To apply knowledge in a specialized area	An ability to apply know ledge in a specialised area related to civil engineering
11.	The management of common works	An understanding of the elements of project and construction management of common civil engineering works
12.	The management of complex works	An understanding of the elements of project and construction management of complex civil engineering works
13.	The professional and ethical responsibility	An understanding of professional and ethical responsibility of civil engineers
14.	The impact of solutions	An understanding of the impact of solutions for civil engineering works in a global and societal context
15.	To communicate effectively	An ability to communicate effectively
16.	The role of the leader	An understanding of the role of the leader and leadership principles and attitudes
17.	The need for life-long learning	A recognition of the need for. and the ability to engage in, life-long learning
18.	To function in multi-disciplinary teams	An ability to function in multi-disciplinary teams

In order to provide comprehensive guidance for the design of programs the following tables provide information on the items and key questions what should be considered. When the contents of this table are generic, the information provided in the previous sections of this Report, can be used in a Civil Engineering specific approach.

Table 5 Key questions for the design of programs

Items	Key questions
Degree profile	• Has the **need for and the potential** of the (new) degree programme been established comprehensively fully and clearly? • Does it aim to satisfy established or new professional and/or social demands? • Was there a **consultation** with stakeholders? Did they identify the need for the degree programme? • Was the **approach** used for the **consultation adequate?** Were the groups selected relevant ones for the degree programme considered? • Are the **definition** of the profile, the identification of the **target groups** to be address and its place in the national and international setting **clear?** • Is there convincing evidence that the profile will be **recognized** in terms of **future employment?** Is it related to a specific professional or social context? •Is this profile **academically challenging** for staff and students? •Is there **awareness of the educational context** in which the programme is offered?
Learning outcomes	• Have **clear and adequate learning outcomes** been identified at the level of the programme as a whole and of each of its components? • Will they result in **the profile** identified? Are they adequately distributed over the various parts of the programme? • Is the progression and coherence of the programme and its units sufficiently guaranteed? • Are the learning outcomes **formulated in terms of subject-specific and generic** com**petences** covering knowledge, understanding, skills, abilities and values? • What guarantee is there that the learning outcomes will be **recognized and understood** within and outside Europe?
Competences	• Are the **competences** to be obtained by the student clearly **identified and formulae** both subject-specific and generic? • Is the **level** of the competences to be obtained appropriate for this specific degree programme? • Are the competences to be gained expressed in such a way that they can actually **be measured?** • Is **progression guaranteed** in the development of the competences? • Can the competences obtained be assessed adequately? Is the **methodology of assessment** of the competences clearly specified and suitable for the **expressed learning outcomes?** • Are the approaches chosen for **learning and teaching** the competences clearly **spe| tied?** What evidence is there to assure that the results will reached? • Are the approaches chosen sufficiently **varied and innovative / creative?** • Are the competences identified **comparable and compatible** with the **European reference points** relative to the subject area? (if applicable)

Items	Key questions
Level	• Has the **entrance level** of potential students been taken into consideration when identifying their learning needs? • Does the level of learning outcomes and competences correspond to the **level(s)** of degree (cycle) foreseen in the **European and National Qualification Framework** • If sublevels are included, are these described in terms of learning outcomes expressed in competences? • Are levels described in terms of: - acquiring knowledge, understanding, skills and abilities - applying knowledge, understanding, skills and abilities in practice - making informed judgments and choices- - communicating knowledge and understanding - capacities to continue learning
Credits and Workload	• Is the degree programme **ECTS based?** Is it in alignment with the **ECTS key feature?** • Have **credits** been allocated to the programme? How is the adequacy of this **allocation** guaranteed? • How are credits related to the **learning outcomes** of this programme? • How is the **correlation** between **workload and credit** allocation checked? • How is a **balanced** student workload guaranteed during each learning period in term of learning, teaching and assessment activities? • What mechanisms are used for **revision** of credit allocation and learning, teaching and assessment activities? How are the students involved in this process? • Is **information** on the programme (modules and/or course units) presented as described in the **ECTS Users' Guide?** • How is **student mobility** facilitated in the programme? • How are **students advised** about mobility? • How are the **key documents of ECTS** used for mobility? • Who is responsible for **recognition** and which are the procedures used?
Resources	• How is the **formal acceptance** of the programme and the resources required to deliver it, guaranteed? • Is the staffing (academic and supporting staff and workplace supervisors) for deliver the programme guaranteed? Does the programme require the use of teaching staff from outside the department/institution? • Is **staff development** foreseen in terms of (new) approaches to learning, teaching or assessment? • How are the necessary **structural, financial and technical means** (class rooms, equipments, health and safety procedures etc.) guaranteed? In the case of workplace learning/placements, are there sufficient and suitable **placements** guaranteed?

Programme delivery, maintenance and evaluation

Table 6

Monitoring	▪ How is **the quality of delivery** of the programme and its components monitored? ▪ How is **staff quality and motivation** for the delivery of the programme monitored? ▪ Are there systems in place to **evaluate** the quality of the learning environment in **work** place learning/placements? ▪ Is the quality of class rooms and the equipment (including workplace environment required to deliver the programme sufficient? ▪ How is the entrance level of potential students monitored? ▪ How is student performance monitored in terms of quality of learning outcomes to be obtained / competences to be achieved and time required to complete the programme and its components? ▪ In what way is the employability of graduates monitored? ▪ How is the alumni database organized? ▪ Are data collected on the graduates' satisfaction with the programme?
Updating	▪ How is the system for updating / revision of the degree programme organized? ▪ In what way can changes related to external developments in society be incorporate in the programme? ▪ How is staff development related to programme updating organized and guaranteed
Sustainability and responsibility	▪ How is the sustainability of the programme guaranteed? ▪ How is it guaranteed that the relevant bodies take responsibility for sustaining and updating of the programme?
Organisation and Information	▪ How is the updating of information regarding the degree programme organized and guaranteed? ▪ How is the adequacy of the system of student support, advising and tutoring ensured? ▪ Is a Diploma Supplement issued to the students automatically and without charge in widely spoken European language?

6. EXEMPLES OF GOOD PRACTICES

6.1. Programme specification for Bachelor in Civil Engineering taught at City University, UK

CITY City University London

CIVB – Beng Civil Engineering

PROGRAMME SPECIFICATION – BEng Civil Engineering

Introduction
This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in the programme handbook. The accuracy of the information contained in this document is regularly reviewed by the University.

The specification also shows how the programme outcomes can be related to the outcomes given in the QAA's subject benchmark statement by indication with: **(B)**.

1. AWARDING INSTITUTION	City University	**AWARD NAME** BEng (Hons) Civil Engineering	
2. TEACHING INSTITUTION	City University	**AWARD HIERARCHY**	
3. HOME SCHOOL	School of Engineering and Mathematical Sciences	**Award**	**Rank**
4. UCAS CODE	H200	BEng (Hons)	1
5. QAA BENCHMARKING GROUP(S)	Engineering	BEng	2
6. DATE OF INTRODUCTION	21NOV 2002	Diploma HE	3
7. DATE OF REVIEW/APPROVAL	27 FEB 2003	Certificate HE	4
8. ADDITIONAL AWARD TITLES	Civil Engineering with Approved Industrial Placement (USCIPB)		

9. ADMISSIONS REQUIREMENTS, INCLUDING AP(E)L ARRANGEMENTS (WHERE APPLICABLE)

Typical offers:
A/AS level: At least 230 UCAS tariff points (160 points of which to come from 6/12 units awards), including A-level mathematics at grade C or above
BTEC: 7 Merits, including mathematics at level (NIII) N/H
IB: 26 including mathematics at higher level

Irish Leaving Certificate: BBBC at higher level, including mathematics at grade C or above
Successful completion of the Westminster - Kingsway College engineering foundation courses
Successful completion of other equivalent engineering foundation courses

AP(E)L:
Direct entry into Part 2 will normally be considered for students who satisfy one of the following:
Successful completion of the first year of a similar accredited BEng course
HND in Civil and Structural Engineering with 6 Merits, including mathematics at level H
NCEA Diploma at Merit Grade 2 or above
Other HND equivalencies (e.g. Cyprus, Hong Kong, Singapore Diplomas)

10. EDUCATIONAL AIMS

The programme aims are to produce graduates who:

- are equipped to pursue effective careers in industry, the professions and public service
- are equipped to solve technical problems with confidence
- are able to apply problem solving skills to design problems
- are able to communicate effectively
- have a practical understanding of management in a professional environment
- are capable of taking into account wider issues relating to the practice of Civil Engineering.

Learning Outcomes: Values and attitudes

Values and Attitudes
PB1
PB2
Maintain a professional engineering attitude
Enhance the welfare, health and safety of the community through engineering solutions.

→

Learning and teaching methods
Values and attitudes are promoted through industrial involvement, design projects and essay type coursework.
Assessment Methods
The learning outcomes are not directly assessed.

13. PROGRAMME STRUCTURE, LEVELS, MODULES, CREDITS AND AWARD REQUIREMENT

Parts	Credit Value
1	125
2	130
3	135

The programme, which is only offered as a full time course, is divided into three Parts (Parts 1, 2 and 3), each occupying a full academic year. The programme normally lasts for three years and leads to a BEng degree that is accredited by the Institution of Civil Engineers and the Institution of Structural Engineers. At the end of Part 2, students who meet the required criteria have the option of transferring to the MEng (Hons) degree. Students who wish to gain practical experience have the option of spending a year on paid industrial placement, usually between Parts 2 and 3. The core civil engineering subject areas, Structures, Geotechnics, and Hydraulics are studied in all years of the programme. Mathematics, Surveying and Management are the other key subjects areas. Design, which runs through from Part 1 to Part 3, is at the heart of the course and it correlates the theoretical concepts studied in each part with the practical experience gained. Industrial involvement is a key feature of the programme. Lecturers from industry are invited to make presentations in all parts of the programme. In Parts 2 and 3 of the programme, design projects, which familiarise students with professional practice, are set and reviewed by practicing consulting engineers. Students are encouraged to take up opportunities available through the Open Door to Industry scheme and organised site visits.

Mode of delivery	**Duration in years**
Full Time	3
Full Time (Sandwich)	4

Part 1

Programme Structure

Part 1 consists of 10 compulsory HE1 level modules, totalling 125 credits. Students are required to take all modules at this level.

The Geology module includes a compulsory residential field trip.

Modules are assessed by written examinations, tests, coursework, and laboratory and design reports. Submission dates for coursework, laboratory and design reports, which are assessed throughout the year, are published in a coursework schedule. Seen and unseen tests are carried out at the start of the second term and unseen examinations take place in the third term.

Students are required to take the following core modules in this part:

Group	Code	Title	Level	Credit Value	Compensation Permissible
COM1	CV1301	Geology for Engineers	1	20	N
COM1	CV1302	Hydraulics	1	10	N
COM1	CV1303	Structural Mechanics	1	20	N
COM1	CV1304	Surveying & Statistics	1	5	N
COM1	CV1305	Design & Graphics	1	15	N
COM1	CV1306	Materials	1	15	N
COM1	CV1307	IT Computing & CAD	1	10	N
COM1	CV1308	Civil Engineering Practice	1	5	N
COM1	ET1051	Engineering Management 1	1	5	N
COM1	EX1001	Engineering Mathematics 1	1	20	N

Outcomes developed/assessed in this Part include:

PA1 Comprehensive knowledge and understanding of analytical engineering subjects (B)
PA2 Wide knowledge of Civil Engineering operations (B)
PA3 An understanding of the design process and the ability to carry out a design task (B)
PA4 A good understanding of management principles as applied to engineering (B)
PA5 An awareness of the role of the professional engineer and the wider issues relating to society, the environment and sustainability (B)
PB1 Maintain a professional engineering attitude
PB2 Enhance the welfare, health and safety of the community through engineering solutions
PC1 Plan, conduct and report work of an investigate nature
PC2 Use analytical and experimental techniques to solve problems in engineering (B)
PC3 Design a system or element to meet specifications taking a range of constraints into account (B)
PC4 Synthesize and evaluate critically, information and data from various sources (B)
PD1 Plan and carry out experimental work (B)
PD2 Use a range of laboratory equipment to obtain data, carry out an analysis of it and comment on the results (B)
PD3 Prepare technical reports and drawings and make technical presentations (B)
PD5 Use computer packages for analysis and design (B)
PE1 Communicate effectively through writing, drawings and oral presentations (B)
PE2 Solve problems using analytical and mathematical skills (B)
PE3 Work effectively in teams (B)
PE4 Make use of Information Technology tools (B)
PE5 Manage resources and time (B)

Requirements for progression to the next part and interim award regulations

PB2 Enhance the welfare, health and safety of the community through engineering solutions
PC1 Plan, conduct and report work of an investigate nature
PC2 Use analytical and experimental techniques to solve problems in engineering (B)
PC3 Design a system or element to meet specifications taking a range of constraints into account (B)
PC4 Synthesize and evaluate critically, information and data from various sources (B)
PD1 Plan and carry out experimental work (B)
PD2 Use a range of laboratory equipment to obtain data, carry out an analysis of it and comment on the results (B)
PD3 Prepare technical reports and drawings and make technical presentations (B)
PD4 Interrogate published scientific literature effective (B)
PD5 Use computer packages for analysis and design (B)
PE1 Communicate effectively through writing, drawings and oral presentations (B)
PE2 Solve problems using analytical and mathematical skills (B)
PE3 Work effectively in teams (B)
PE4 Make use of Information Technology tools (B)
PE5 Manage resources and time (B)

Requirements for progression to the next part and interim award regulations

PART 1 PROGRESSION REGULATIONS

To pass Part 1, the student must have acquired 125 credits. A candidate for Honours who has not satisfied the requirement to progress to Part 2 but has failed no more than 20 credits at Part 1 may, at the discretion of the Board of Examiners, be allowed to proceed as a candidate for a Bachelors Degree (Ordinary). Resit after First Attempt Where there has been a valid first attempt, resit provisions will apply to all failed modules provided that:
- the method and date of resit, shall be prescribed by the Assessment Board in accordance with the module regulations;
- a module may normally be resat only once;

A student who does not satisfy his or her resit by the date specified shall not progress to the next Part and the Assessment Board shall make a recommendation to Senate that they withdraw. The Assessment Board may, at its discretion, permit a student to resit during the course of the following year, with or without attendance. A student who successfully completes a resit shall be awarded the credit for the Module. The mark used for the purposes of calculation towards the Award shall be the greater of the minimum pass mark for the Module or the original mark for the Module obtained at the first attempt. Failure in a Part and the Award of a Lower Level Qualification. Where a student fails to meet the requirements for a particular Part, having exhausted all resit opportunities, but satisfies the requirements for the previous Part and where the previous Part is designated in the Programme Scheme as attracting a specified qualification, then the lower level qualification associated with that Part will be awarded.

Fail Withdraw
Where a student fails to meet the requirements for a particular Part and is not eligible for the award of a lower level qualification, the Assessment Board shall
require the student to withdraw from the Programme.
Interim Award Certificate of Higher Education

Part 2

Programme Structure

Part 2 consists of 9 compulsory HE2 level modules, totalling 130 credits. Students are required to take all modules at this level.

The Surveying module includes a compulsory residential field trip.
Modules are assessed by written examinations, tests, coursework, and laboratory and design reports. Submission dates for coursework, laboratory and design reports, which are assessed throughout the year, are published in a coursework schedule. Seen and unseen tests are carried out at the start of the second term and unseen examinations take place in the third term.

Students who wish to gain practical experience have the option of spending a year on paid industrial placement, usually between Parts 2 and 3 (Module ET2010).

Students are required to take the following core modules in this part:					
Group	**Code**	**Title**	**Level**	**Credit value**	**Compensation Permissible**
COM1	CV2301	Soil Mechanics	2	20	N
COM1	CV2302	Fluid Mechanics	2	20	N
COM1	CV2303	Structural Analysis	2	20	N
COM1	CV2304	Surveying	2	20	N
COM1	CV2305	Design & Construction	2	10	N
COM1	CV2306	Structural Design	2	10	N
COM1	CV2307	Numerical Methods	2	5	N
COM1	CV2318	Engineering and Construction Management	2	15	N
COM1	EX2002	Engineering Mathematics 2 (CIVIL)	2	10	N

PA1	Comprehensive knowledge and understanding of analytical engineering subjects(B)
PA2	Wide knowledge of Civil Engineering operations(B)
PA3	An understanding of the design process and the ability to carry out a design task(B)
PA4	A good understanding of management principles as applied to engineering(B)
PA5	An awareness of the role of the professional engineer and the wider issues relating to society, the environment and sustainability(B)
PB1	Maintain a professional engineering attitude
PB2	Enhance the welfare, health and safety of the community through engineering solutions.
PC1	Plan, conduct and report work of an investigative nature
PC2	Use analytical and experimental techniques to solve problems in engineering (B)
PC3	Design a system or element to meet specifications taking a range of constraints into account (B)
PC4	Synthesize and evaluate critically, information and data from various sources (B)
PD1	Plan and carry out experimental work(B)
PD2	Use a range of laboratory equipment to obtain data, carry out an analysis of it and comment on the results(B)
PD3	Prepare technical reports and drawings, and make technical presentations(B)
PD4	Interrogate published scientific literature effectively(B)
PD5	Use computer packages for analysis and design(B)
PE1	Communicate effectively through writing, drawings and oral presentations(B)
PE2	Solve problems using analytical and mathematical skills(B)
PE3	Work effectively in teams(B)
PE4	Make use of Information Technology tools(B)
PE5	Manage resources and time(B)

Requirements for progression to the next part and interim award regulations

PART 2 PROGRESSION REGULATIONS

To pass Part 2, the student must have acquired 130 credits. A candidate for Honours who has not satisfied the requirement to progress to Part 3 but has failed no more than 20 credits at Part 2 may, at the discretion of the Board of Examiners, be allowed to proceed as a candidate for a Bachelors Degree (Ordinary).
Resit after First Attempt

Where there has been a valid first attempt, resit provisions will apply to all failed modules provided that:
- the method and date of resit, shall be prescribed by the Assessment Board in accordance with the module regulations;
- a module may normally be resat only once;
- A student who does not satisfy his or her resit by the date specified shall not progress to the next Part and the Assessment Board shall make a recommendation to Senate that they withdraw.

The Assessment Board may, at its discretion, permit a student to resit during the course of the following year, with or without attendance.
A student who successfully completes a resit shall be awarded the credit for the Module. The mark used for the purposes of calculation towards the Award shall be the greater of the minimum pass mark for the Module or the original mark for the Module obtained at the first attempt.

Failure in a Part and the Award of a Lower Level Qualification
Where a student fails to meet the requirements for a particular Part, having exhausted all resit opportunities, but satisfies the requirements for the previous Part and where the previous Part is designated in the Programme Scheme as attracting a specified qualification, then the lower level qualification associated with that Part will be awarded.

Fail Withdraw
Where a student fails to meet the requirements for a particular Part and is not eligible for the award of a lower level qualification, the Assessment Board shall require the student to withdraw from the Programme.

Interim Award Diploma of Higher Education

Part 3

Programme Structure

Part 3 consists of 7 compulsory modules, and one elective. All modules are at HE3 level, totalling 135 credits. Students are required to take all compulsory modules and select any two modules from a list of electives (Geomatics and Architectural Surveying cannot be taken together).

For the Major Project each student is required to choose a project title and supervisor at the start of the year. This module, which is assessed through written reports, presentations and oral examination, is not compensatable.

Other modules are assessed by written examinations, tests, coursework, and laboratory and design reports. Submission dates for coursework, laboratory and design reports, which are assessed throughout the year, are published in a coursework schedule. Unseen examinations take place in the third term.

Students are required to take the following core modules in this part:					
Group	**Code**	**Title**	**Level**	**Credit value**	**Compensation Permissible**
COM1	CV3301	Geotechnical Engineering	2	20	Y
COM1	CV3302	Hydraulic Engineering	2	20	Y
COM1	CV3303	Structural Engineering	2	20	Y
COM1	CV3305	Intensive Design Project	2	10	Y
COM1	CV3308	Engineering Management	2	15	Y
COM1	CV3310	Civil Engineering Paper	2	5	Y
COM1	CV3309	Major Project	2	25	N
COM1	CV3301	Geotechnical Engineering	2	20	Y
COM1	CV3302	Hydraulic Engineering	2	20	Y
Students may select modules from the following list: (See 'Programme Structure' for full details)					
Group	**Code**	**Title**	**Level**	**Credit value**	**Compensation Permissible**
ELT1	CV3311	Transportation & Highways	3	10	Y
ELT1	CV3312	Environmental Control & Public Health	3	10	Y
ELT1	CV3313	Building Engineering	3	10	Y
ELT1	CV3314	Geomatics	3	10	Y
ELT1	CV3315	Architectural Surveying	3	10	Y

Outcomes developed/assessed in this Part include:	
PA1	Comprehensive knowledge and understanding of analytical engineering subjects(B)
PA2	Wide knowledge of Civil Engineering operations(B)
PA3	An understanding of the design process and the ability to carry out a design task(B)
PA4	A good understanding of management principles as applied to engineering(B)
PA5	An awareness of the role of the professional engineer and the wider issues relating to society, the environment and sustainability(B)
PB1	Maintain a professional engineering attitude
PB2	Enhance the welfare, health and safety of the community through engineering solutions.
PC1	Plan, conduct and report work of an investigative nature
PC2	Use analytical and experimental techniques to solve problems in engineering (B)
PC3	Design a system or element to meet specifications taking a range of constraints into account (B)
PC4	Synthesize and evaluate critically, information and data from various sources (B)
PD1	Plan and carry out experimental work(B)
PD2	Use a range of laboratory equipment to obtain data, carry out an analysis of it and comment on the results(B)
PD3	Prepare technical reports and drawings, and make technical presentations(B)
PD4	Interrogate published scientific literature effectively(B)
PD5	Use computer packages for analysis and design(B)
PE1	Communicate effectively through writing, drawings and oral presentations(B)
PE2	Solve problems using analytical and mathematical skills(B)
PE3	Work effectively in teams(B)
PE4	Make use of Information Technology tools(B)

PE5	Manage resources and time(B)
Requirements for progression to the next part and interim award regulations	

PART 3: PASS REGULATIONS

To pass Part 3, the student must have acquired 135 credits as specified in Part 3 of the Programme Scheme and have successfully completed the professional placement, if applicable.

Compensation between Modules at First Attempt
Where a student fails up to 30 credits at the Part, at a valid first attempt, the Assessment Board may consider the application of compensation, provided that:
- Modules have been taken in a single valid attempt, including where resits have taken place; this means that students must have taken all assessments
associated with the Part within the normal specified time for that Part; and;
- Compensation is permissible for the module(s) in question, as set out in the Programme Scheme, thus ensuring that all Programme Route Learning
Outcomes have been safisfied and;
- a minimum mark of no more than 10 percentage points below the Module pass mark has been achieved in the Module to be compensated and;
- an aggregate mark of 40% has been achieved for the Part.

A student who receives a compensated pass in a Module shall be awarded the credit for the Module. The original component marks shall be retained in the record of marks and the greater of the original Module Mark and the minimum pass mark for the Module shall be used for the purpose of calculation towards the Award.
Resit after First Attempt

Where compensation is not permissible and there has been a valid first attempt, resit provisions will apply to Modules totalling a maximum of 45 credits provided that:
- the method and date of resit, shall be prescribed by the Assessment Board in accordance with the Module regulations;
- a Module may be resat only once.

The Assessment Board may, at its discretion, permit a student to resit during the course of the following year, with or without attendance.A student who successfully completes a resit shall be awarded the credit for the Module. The mark used for the purposes of calculation towards the Award shall be the greater of the minimum pass mark for the Module or the original mark for the Module obtained at the first attempt.

Failure at Part 3 and the Award of a Lower Level Qualification Where a student fails to meet the requirements for a particular Part, having exhausted all resit opportunities, but satisfies the requirements for the previous

Part and where the previous Part is designated in the Programme Scheme as attracting a specified qualification, then the lower level qualification associated with that Part will be awarded.

6.2 Example of Basic information of the Bachelor course at Civil Engineering Faculty, Technical University of Cluj-Napoca, ROMANIA

Subject name	**Earthquake Engineering**
Field of study	Civil Engineering
Subject code	4304208
Subject main teacher	Professor Doina VERDES;
Colaborators	Prep. Drd. Eng. Claudia TURCU
Department	Civil Buildings-Foundations-Construction Materials
Faculty	Civil Engineering

Sem.	Type of subject	Course	Applications			Course	Applications	Individual Study	Total	Credits	Type examination
		classes/week				classes/semester					
		C	S	L	P	C	L				
6	Speciali-sation	2	-	2	-	28	28	48	104	4	Exam

Prerequisits: Statics, Dynamics, Reinforced concrete structures; Steel structures

Theoretical knowledge, (What the students must know)

- to understand the earthquake's mechanism and the territory's seismicity;
- to know the seismic response of buildings using elastic and inelastic analyses
- to know and understand specific criteria for earthquake resistant design
- basics of seismic protection of buildings

Achieved skills

The computation of seismic response for various structural systems for common buildings; The basis of buildings and structural elements design complying with seismic design principles; The modern seismic protection systems.

Achieved abilities:

- to evaluate the seismic response of single and multi level buildings having the structural system with moment resistant frames and shear walls to calculate the seismic forces including the torsion effect
- to use the laboratory shake table testing equipment

<table>
<tr><td colspan="2">Previous requirements (if necessary)</td></tr>
<tr><td colspan="2">Dynamics, Mechanics, Reinforced Concrete</td></tr>
<tr><td colspan="2">A. Course

Basics of seismological and engineering study of the earthquakes
Linear and nonlinear seismic response of Single Degree of Freedom System; Linear and nonlinear Seismic response of Multi Degree of Freedom System; Conceptual design of buildings; The torsion effect on the structural system; The concepts of seismic protection: traditional design to accomplish the requirements for ductility, resistance and stiffness. The displacement analysis. Nonstructural elements. The Basics of seismic response control. The passive control systems. The base isolation. The active control systems. The hybrid control systems</td></tr>
<tr><td colspan="2">B1. Applications – WORKS (list of works, seminar works, contents of the year end project)

The calculation of the equivalent static seismic force for a one level building. The calculation of the seismic response of one level building using numerical integration procedure: the Vrancea 1977 earthquake. The seismic response for a multi level reinforced concrete framed structure – calculation of the base equivalent seismic load. The calculation of seismic level loads and the level stiffness and the torsion effect. The distribution of seismic load to the vertical structural system. The seismic response for a multilevel reinforced concrete shear walls structure. The calculation of seismic level loads, the torsion effect. The practical laboratory work: the seismic response of a system with one mass attached dumper; the presentation of the installation. The test on the shake table of the one level building with attached mass damper.</td></tr>
<tr><td colspan="2">B2. Laboratory room (Room/surface, address) Room 212 Baritiu 25/48 sqm</td></tr>
<tr><td>Equipment</td><td>Equipment description</td></tr>
<tr><td>Shake table testing system
The table 70x70 cm^2

The computer
The software
The Model</td><td>Facilitates hands-on student involvement
Downloads and replays real-life earthquake data from various motion data bases; Integrates high-performance Real-time Control; Includes Extensive Data Acquisition features; Several optional structures for extended capabilities; Features Single (x-axis) configurations; Supports LabView or MATLAB & Simulink software for highly flexible, diverse functionality;
LG Computer PC - Procesor Pentium IV/3GHz/Mem.1024MB/ HDD 200GB/DVD-RW/Monitor LG 19”/Tast.+Mouse;
WinCon 5.0 (w/Q4 or Q8) - Real-Time Rapid Control Prototyping - for operation on Microsoft Windows XP / 2000 Professional
The Model : one level building with attached mass damper</td></tr>
<tr><td>The Computer</td><td>PC- Procesor Pentium; Monitor LG 19”/Tast.+Mouse
Microsoft Windows XP / 2000; Mathlab, Mathcad software</td></tr>
</table>

C. Individual study (topics of the bibliographical studies, summarized materials, projects, applications etc.) The seismic response of the 1DOF and MDOF sistems using the procedure of statical equivalent force. The seismic design of reinforced concrete structures. Systems for seismic protection of the buildings.					
Structure Individual study	Course study	Solving homeworks, labs, projects	Time allowed for examinations	Supplemen-tary study	Total
No. of classes	30	5	10	3	48

D. Teaching methods and strategies

Lectures starts with the subject to be discussed and its connection in the general context of the course; The new issues are demonstrated through demonstrations performed step-by-step at the blackboard, in order to give an understanding of the physical phenomenon and the calculation model; Interactive style (questions and answers);
Continuous learning: each week the students must solve homework which represent a base for the evaluation of their activity; Tutorial activity: 1 hour/week, individual or group consultations.

Examination procedure	The examination consists in a written test and oral defense of the laboratory works
Components of the grade	Theory (note T); Lab Applications (note A);
Formula for calculating the grade	$N=0,7T+0,3A$; Condition of credits acquiring : $T\geq5$, $A\geq5$; $N\geq5$
Examination procedure	The examination consists in a written test and oral defense of the laboratory works
Components of the grade	Theory (note T); Lab Applications (note A);
Formula for calculating the grade	$N=0,7T+0,3A$; Condition of credits acquiring : $T\geq5$, $A\geq5$; $N\geq5$

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA VALID FROM: 2009/2010
FACULTY OF CONSTRUCTIONS
FIELD: CIVIL ENGINEERING
SPECIALIZATION: CIVIL, INDUSTRIAL AND AGRICULTURAL CONSTRUCTIONS

SYLLABUS

Name of the subject	Code	Third year										Assess-ment			Nr. of hours/subject				Cred-its / se-mester	
		Sem 5 14 weeks					Sem 6 14 weeks													
		C	S	L	P	P	C	S	L	P	P	E	C	V	Tot	C	Aplic	Indiv st	1	2
STATICS II	63309	3		2								M			156	42	28	86	6	
THEORY OF ELASTICITY AND PLASTICITY	63409	2		1								M			104	28	14	62	4	
REINFORCED AND PRESTRESSED CONCRETE	63509	3		3								M			156	42	42	72	6	
BUILDINGS (I)	63609	3		3								M			156	42	42	72	6	
COMMUNICATION S WAYS	63706	2		2									M		104	28	28	48	4	
MANAGEMENT AND ADMINISTRATION WORKS	63809	1		1									M		52	14	14	24	2	
OPTIONAL COURSE NO. 1	63909	1											M		52	14	0	38	2	
CONCRETE STRUCTURES	64009						2			3		M			104	28	42	34		4
BUILDINGS (II)	64109						2		2				M		104	28	28	48		4
TECHNOLOGY OF CONSTRUCTIONS	64609						1		1				M		52	14	14	24		2
EARTHQUAKE ENGINEERING	64209						2		2			M			104	28	28	48		4
TIMBER STRUCTURES	64409						2		1			M			78	28	14	36		3
FIRE SAFETY OF CONSTRUCTIONS	64509						2							A/R	52	28	0	24		2
STEEL STRUCTURES (I)	64309						2		2			M			104	28	28	48		4
TECHNOLOGY OF CONSTRUCTIONS	64609						1		1				M		52	14	14	24		2
DYNAMICS AND STABILITY	64709						2		1				M		52	28	14	10		2
PRACTICAL WORK	64809													A/R	130	0	0	130		5
															1560	392	456	712	28	32
TOTAL		15	0	12	0	0	15	0	9	3	0									
		27					27													

6.3 Course taught at the Civil Engineering Department, Postgraduate Program Aristotle University, Thessalonica, GREECE "Protection and Restoration of Groundwater"

Protection and Restoration of Groundwater is a course taught at The Postgraduate Program "Environmental Protection and Sustainable Management" of the Civil Engineering Department of the Aristotle University, Thessaloniki, Greece
http://ppva.civil.auth.gr/content/en/courses/ppba6.html
Instructors: Latinopoulos P., Katsifarakis K.

Aim

The acquisition of theoretical and practical knowledge and experience in order to solve problems concerning the protection and restoration of groundwater regarding all crucial cases of harm and types of pollution.

Objectives

After successfully attending the course the postgraduate student should be capable of:

- Distinguishing the various types of pollutants and the degrees of groundwater pollution.
- Understanding the transport mechanisms of the pollutants in aquifers and the importance of the natural and chemical parameters and processes.
- Dealing with and solving problems related to the protection of groundwater
- Applying restoration methods and techniques of groundwater for various types of pollutants and aquifers.

All courses of this program are described in terms of course aim and course objectives:
http://ppva.civil.auth.gr/content/en/program.html
In the Greek version, the course contents are included as well. For example, see:
http://ppva.civil.auth.gr/content/courses/ppba6.html

6.4 Course taught at the Civil Engineering Department, National Technical University of Athens, GREECE

Environmental Geotechnics

The overarching goal of the course is to develop environmental thinking related to (1) assessing the severity of a contaminant release in the subsurface, (2) recognizing the physical-chemical-biological mechanisms that affect the fate and transport of the released contaminant and, (3) selecting appropriate remedial measures and/or technologies.

Course objectives are met if at the end of the semester students:

(a) can locate reliable data on the effects of contaminants on human health,

(b) are confident in applying principles of mass transfer, groundwater flow and contaminant transport to problems of contamination and restoration of the subsurface,

(c) are able to address the geo-environmental aspects of landfill and clay barrier design, (d) are familiar with a wide range of remediation technologies,

(e) are able to take initiatives related to modeling (i.e., related to the formulation of a simplified problem that admits solution) and,

(f) are aware of some social or public policy dimensions of subsurface contamination and restoration problems.

Course contents include the following. Cases of restoration of contaminated sites. Legislation. Sources and characteristics of contaminants. Risk assessment. Groundwater flow. Soil-contaminant interaction. Mechanisms affecting the fate of contaminants, contaminant transport, applications (practice in the use of an educational software in the School's PC lab). Landfill liner design and materials. Remediation technologies for contaminated sites.

Instructor: Marina Pantazidou

Environmental Geotechnics is a course taught at the 5th year of the Civil Engineering School, National Technical University of Athens, Greece

Course website (material in Greek):

http://www.civil.ntua.gr/ggeotechenviron/

6.5 Specialisation Post Master taught at the Higher Institute of Building and Public Works (ISBA-TP) of Marseille (FRANCE) : Bridges design or Infrastructure and Geotechnical design.

ISBA TP

Outcome Based Courses

National Qualifications Board **Summary Description of the Certification**	CNCP Commission Nationale de la Certification Professionnelle

Title

Ingénieur Diplômé de l'Institut Supérieur du Bâtiment et des Travaux Publics

Spécialité « ouvrages d'art »	
Authority responsible for certification	**Quality (es) signatory (s) of certification**
Higher Institute of Building and Public Works	Higher Education Minister Chamber of Commerce President ISBA-TP Dean

Summary of reference or job skills acquired elements

List of activities covered by the diploma, title or certificate :

The Higher Institute of Building and Public Works aims to specialise and certify qualified engineers. They can perform the following tasks, classified by type of position in civil engineering and construction :

Structural engineers in design department or control office :

- Studies of technical design and construction of buildings, civil works or bridges
- MOT
- Technical assistance
- Coordination of operations
- Asset Tracking
- Conducting research and development activities

Engineer on construction sites :

- Develop markets
- Negotiates costs with subcontractors
- Organises construction
- Anime oversees and manages the teams work
- Prepares invoices and work situations

Proven skills or abilities:

Certification involves verifying the following qualities:

- Ability to mobilise resources from a wide field of basic sciences.
- Knowledge and understanding of a range of scientific and technical expertise.
- Control methods and tools for engineers: identification and resolution of problems, even in unfamiliar and not completely defined, collection and

interpretation of data, use of computer analysis and design of complex systems experimentation.

- Ability to integrate into an organisation, to animate and make the change : commitment and leadership, project management, project contracting, communication with experts as with non-specialists.
- Taking into account the challenges facing industry, economic and business : competitiveness and productivity, innovation, intellectual and industrial property, compliance with quality procedures, safety.
- Ability to work in international environment: control of one or more foreign languages, security, intelligence, cultural openness, international experience.
- Respect for societal values: knowledge of social relationships, environment and sustainable development, ethics.

<u>Knowledge, skills or special abilities developed in the certification :</u>

- Ability to study the feasibility of contracting projects of large scale construction (buildings and structures) including seismic zone;
- Ability to manage these projects by optimising the cost, quality and deadlines and coordinate their implementation;
- Ability to develop technical and administrative assistance to these projects and carry out the study execution;
  - Ability to provide leadership responsibilities of a team study
  - Ability to provide technical expert mission;
  - Knowledge of tools and methods for determining how comprehensive or interim technical processes, methods of organisation and the cost of construction operations;
  - Ability to plan and organise, from a file, the various tools and resources to perform the work, to ensure accountability technical, administrative and budgetary one or more sites.

Companies or types of jobs available by the holder of such diploma, title or certificate:

<u>Companies :</u>

These professionals are employed by construction companies or public works, engineering companies, offices or government control.

Job Type :

Project manager structure in design department or office supervision;
Project leader in construction methods;
Supervisor.

Program Description – 2009/2010	
ISO 9001 V2000 certified by	ISO 9001 DNV n°0016-2004-FR

- Update 18/06/09
- Training Unit: HIGHER INSTITUTE OF BUILDING AND PUBLIC WORKS
- Program Title: Specialisation in Structures Design or Infrastructure and Geotechnical Design.
- Goal: To train senior-level specialised structure calculation of structures or structural calculation in contact with the ground.
- Program design: B. LE TALLEC - G. LAPLACE
- Duration: 1445 hours
- **Courses: (456 hours)**

Common Core				
Subject		Schedule	**Coef**	ECTS
Soil mechanics 1	1 internal teacher	60 H + 10 H	1	2
Earthquake Engineering	2 external teachers	36 H	1	2
Steel structures	1 external teacher	40 H	1	2
Concrete structures 1	1 external teacher	68 H + 10 H	2	2
Structure modelling	1 internal teacher	32 H	1	2
Building design	1 external teacher	36 H	1	2
Construction cost	1 external teacher	24 H	1	1
Construction law	1 external teacher	20 H	1	1
Contracts	1 external teacher	16 H	1	1
English language	Individual work		1	1

Bridges design specialisation				
Concrete structures 2	1 internal teacher	36 H + 4 H	2	3
Bridge design	1 internal teacher 2 external teachers	64 H	2	4

Infrastructures and geotechnical design specialisation				
Soils mechanics 2	2 external teachers	28 H + 4 H	1	2
Marine Works (harbour design)	2 external teachers	28 H	1	2
Tunnels	2 external teachers	28 H	1	2
Dams	1 external teacher	16 H	1	1

- **Lectures and Site visits : (60 hours)**

The Eurocodes – Eurocode 0	4 H - October
Mission of the engineer in Civil Engineering	4 H - October
Eurocode 1	16 H - November
Human resources - EXPECTRA	4 H - November
Prefab concrete products – KP1	4 H - November
Soils consolidation – SOLETANCHE/KELLER	4 H - January
Steel products used in Civil Engineering - Piling - Rolled products - ARCELOR/MITTAL	4 H - January
Site visits	16 H

- **Exams** : (48 h)

- **Final projects** : (300 h)

		Schedule	Coef	ECTS
Building project	3 external teachers	150 h	3	10
Specialisation project	1 internal teacher 3 external teachers	150 h	3	10

- **Individual technical study** : (56 h)

- **Company training** : (525 h)

The website of the Higher Institute of Building and Public Works is: http://www.isba.fr

REFERENCES

[1] Spady W. Outcomes Based Education; Critical issues and answers Arligton, VA; American Association of School administrators, 1994
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[4] Civil Engineering Body of Knowledge for the 21st Century, Second Edition, ASCE,2008,,http://www.asce.org/uploadedFiles/Leadership_Training_-_New/BOK2E_%28°ASCE_2008%29_ebook.pdf
[5] EUR-ACE, Framework standards for the Accreditation of Engineering Programmes, document A1 – en Final, 17 November 2008, http://www.feani.org/webenaee/pdf/EURACE_Framework_Standards_2011 0209.pdf
[6] Inquiries into European Higher Education in Civil Engineering EUCEET, Edited by Iacint Manoliu ISBN 973-85112-8-3 Vol.5.-2006.

APPENDIX 1

1. OBE Questions

Questions to EUCEET delegates

How familiar were you with OBE ?
Not at all, somewhat, a lot
Does your university follow/encourage an OBE-approach?
If yes, could you identify some positive or negative aspects of OBE?
Could you name a good example of a specific curriculum or a specific course designed according to OBE principles? If yes, will you e-mail to Group E information on this example?

University name: *Respondent name*

2. Responses of participants at OBE Questions

How familiar are you with OBE?

A. NOT AT ALL: 4 Respondents

B. SOMEWHAT: 18 Respondents

C. A LOT: 7 Respondents

Does your university follow/encourage an OBE – approach?

A. YES: 20 Respondents

B. NO: 6 Respondents

C. NO REPLY: 2 Respondents

THEME F: Approaches to teaching and learning, assessment and performance in civil engineering education

Report of the
Working Group

THEME F: APPROACHES TO TEACHING AND LEARNING, ASSESSMENT AND PERFORMANCE IN CIVIL ENGINEERING EDUCATION

Report of Working Group

Ralf REINECKE[1]

INTRODUCTION

Based on first evaluations from Theme B "Development of the teaching environment in civil engineering education" special project 6 "Use of ICT in civil engineering education" within the programme of EUCEET II, a continuation in evaluation and explanation of state of the art approaches to teaching and learning was planned within EUCEET III. Since communication technology rapidly evolves and spreads into every part of modern society, a dramatic change within ICT application in higher education could be observed. In addition to a general overview on technologies and their impact on the educational process, several individual approaches from different universities within Europe are given as case studies. Within the working group, we took the opportunity to work with an actual application of ICT, give advice and introduce the methodology in a different course, at a different university in another country, receiving direct feedback on universal applicability, chances and problems.

The Report for the Theme F is supplemented by the two papers based on the contributions at workshops organised under the auspices of the Working Group F.

Survey of ICT applications

Within the thematic network of EUCEET II a broad survey was conducted which covered and described the state of the art of application of ICT in civil engineering education among 18 different European countries. Besides individual efforts, there was also a focus on general applications available at the answering institution, such as the active participation within e-learning or the utilisation of a learning management system (LMS). Since the survey was based on results of a questionnaire, the given data has additionally been verified by research on the published online content (for externals, students and staff).

[1]Chairman of the Working Group for the Theme F;
Dr.-Ing. at IB – REINECKE, Germany

In 2005 only 27% of the responding institutes were taking advantage of a management system. Since this also included basic content management systems (CSM), which had been already available at the point of time of the survey (e.g. ordinary weblog software), the actual number of existing LMS within European universities can be estimated below this percentage.

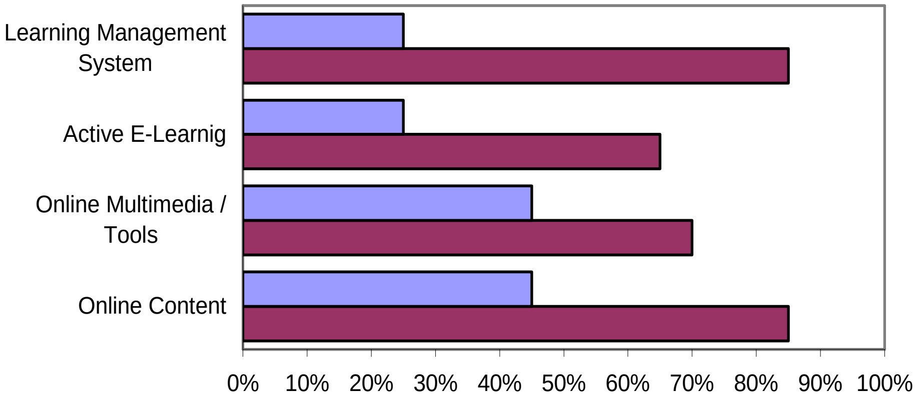


Figure 1: *Development since the EUCEET II SP6 survey - comparison 2005 /2008*

In 2008 the responding institutions were surveyed again and the comparison displayed significant development of technological implementations within the observed universities. The usage of online or multimedia tools in teaching increased by over 60% and other activities such as participation in e-learning or the mere publication of educative content on the university website doubled within the last three years. The most striking increase could be observed within the application of a LMS, which, in most cases, has been imposed on the whole university (students, staff and administration), including support and obligatory use of templates and default tools. This also gives insight on another trend change of ICT application at educational institutions: while application of modern technology and tools in teaching had for long been driven by individuals and enthusiasts, the recent development was mainly caused by a top down approach, which led to more uniform characteristics and allowed an easier exchange and support, and thus causing an acceleration within the increasing number of modern ICT applications.

Figure 2 gives an insight on the most commonly used LMS among academic institutes world wide and also represents the results among EUCEET partners, since almost all universities which apply a commercial LMS use either Moodle or Blackboard.

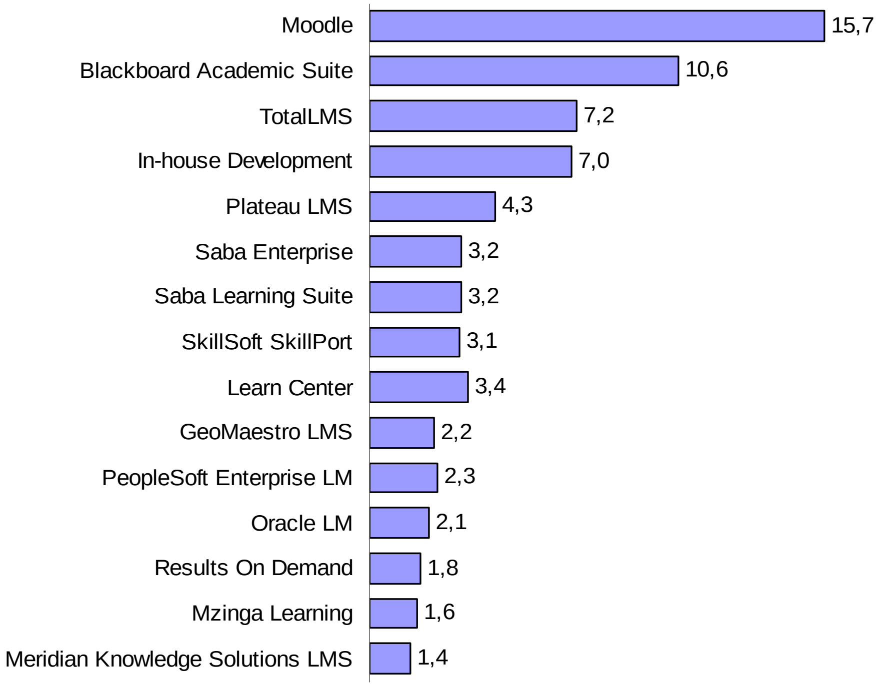


Figure 2: *LMS product usage of academic institutes May 2008* [eLearning Guild Survey]

Pressure to change - reasons in favour of application of modern ICT

Apart from useful applications that may or may not enrich education or the academic life there are several fundamental reasons that enforce the focus on modern technologies applied in higher education.

- The expansion of the Digital Universe

Among the various effects of modern technology on our society, the amount, creation, storage and access of information has changed drastically within the last 20 years. In predigital times, the growth of information was based on the amount of publications each year. Nowadays, the growth of available information is about the size of 300 billion gigabyte per year, which equals roughly 6 million times more books ever written. However the growth of creation, accumulation and storage of information on hard drives (referred to as the digital universe) is still accelerating. Figure 3 shows the evaluated amount of data within a period of the last five years and thus visualising the exponential increase of information each year.

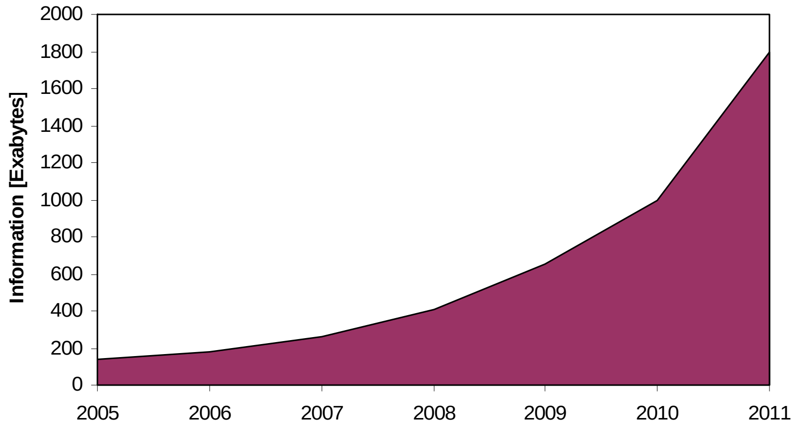


Figure 3: *Expansion of the Digital Universe* [IDC White Paper "The Diverse and Exploding Digital Universe" EMC, March 2008]

The increasing growth of information is a reflection of the access and ability to produce information for individuals. While ten years ago, digital content was mainly created by companies or institutes, modern technologies and digital devices, such as smart phones or digital cameras, now enable individuals to create and share information causing the amount of digital information to double every two years.

- The evolution of Modern Students

It is obvious that the implication of technology has a strong effect on society. Within our society the changes of behaviour and attitudes are strongest among the younger generation. This can clearly be seen by the example of taking a look at the timeline of the internet. That means that a first year student in 2008 does not know a world without the internet.

To get a rough idea on habits and abilities of communication among current students, the Technical University of Munich ran an internal survey study revealing the following results:

- 97% of students own a computer or a laptop
- 100% communicate by email
- 85% use instant messaging
- 85% use social networks
- 83% use course management systems
- 78% play computer and video games

- 79% use downloads from the web
- 70% use ICT for their course research work

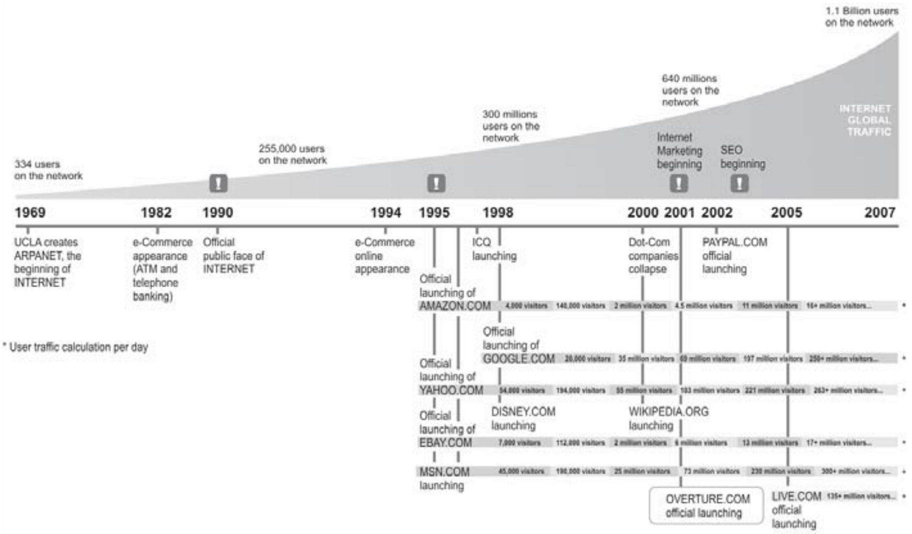


Figure 4: *Evolution timeline of the Internet* [Miguel Angel, Internet Marketing Methods Revealed, Atlantic Publishing Group 2007]

In the case of the Technical University of Munich, it is clear that students not only own the necessary infrastructure, they also are already able to operate common programmes. With hardware prices dropping by half every three years, this trend will only continue to increase. In addition to these prerequisites and skills, the comprehension of modern students is changing as well. While self-education due to better access of information is getting more common, comprehension tends to be broader but also shallower.

- Open source development

The widening access to the internet also led to the so called open source development. This community based collaboration is based on a commonly shared standard which allows access to any possible contributor and thus increases by the size of the contributing community. Simple administrative tools are generally used to maintain a minimum standard of quality compared to commercial equivalents.

Open source can be found in various applications of modern ICT. It does exist in the form of open source technology like in software - for example Linux (computer operating system), Moodle (LMS), Mozilla Firefox (Webbrowser), Wordpress (blog publishing application) and many more. In addition to cooperative development of software, there is the recent development of open content, which has proved to be very successful in sharing information like in the online encyclopaedia Wikipedia.

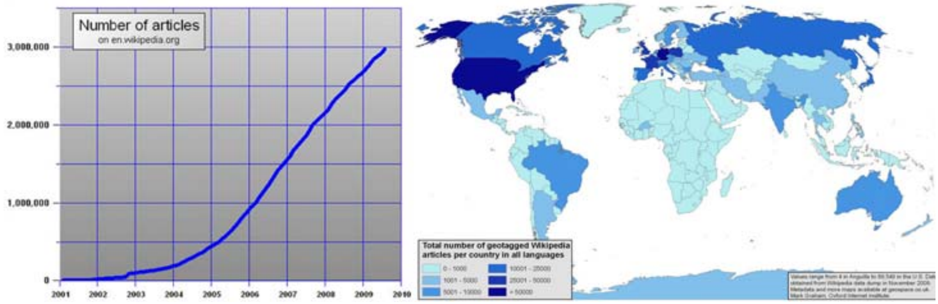


Figure 5: *Development of Wikipedia / Distribution of contributors related to countries* [Wikipedia.org]

The opportunity to share and to discuss content with an active and interested commnity reflects the wisdom of the crowds [James Surowiecki, The Wisdom Of Crowds, 2004] and the increase of content established useful tools for self evaluation and correction as well as for legal purposes (open educational resources: oercommons.org, creative commons, etc.).

- Open Access

In addition to open source, there has been a recent increase of open access to literature and articles in academic publishing that have traditionally been published in scholarly journals with limited access. Lately publishing turned digital and online. Access remains free of charge and free of most copyrights in order to enable free access to knowledge [*"Open Access. Chancen und Herausforderungen – ein Handbuch."* Deutsche UNESCO-Kommission, 2007]. In e-learning, open access is free-to-use providing learning objectives and resources. Open access is essentially the same thing as free content, since a Creative Commons license or similar is typically applied. Most open access material is distributed via the World Wide Web, but is free to redistribute online as well as offline.

There are several financial models in order to establish open access. Some models apply advertisement or governmental funding [Deutsche Nationalbibliothek; http://www.d-nb.de]. (Public Library of Science: plos.org, Google Books books.google.com)

Today more than 90% [Ware, Mark "Scientific Publishing in Transition: An overview of current delevopments" 2006] of all published scientific articles are additionally or exclusively published online. If an article is not accessible online, its contents are also most likely less acknowledged in further publications.

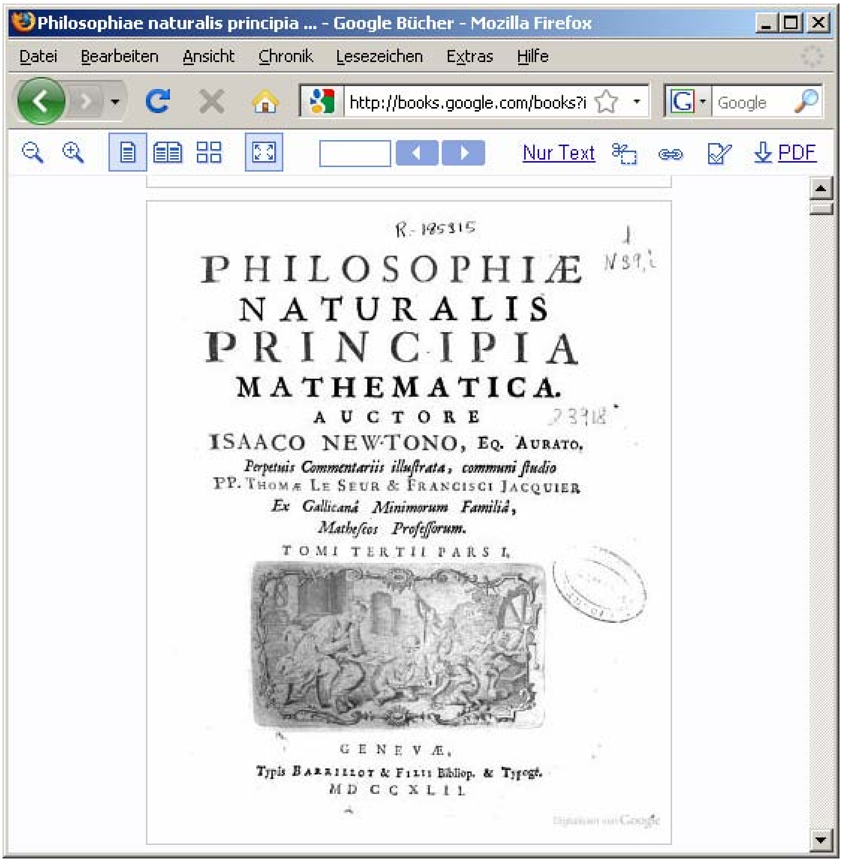


Figure 6: *Web based open access of Isaac Newtons Principia Mathematica* [books.google.com]

- Open Teaching

The mentioned developments are already reflected in modern teaching as sharing and improving of educational resources is practiced in open teaching forums.

Within all these recent significant developments, it is obvious that higher education is under pressure to change or at least to adapt to the already performed changes in society and communication. While conventional education is authoritative, controlled and linear, the growth and management of information strongly leads to decentralisation, suspended certainty and democratisational processes. Due to the controversial nature it is not possible to enable an easy transition.

Adapting education to changes in society

The expansion of the digital universe, the changing attitudes withing the new genrations of students and the open source development of technology have already caused major changes in our society. In addition to globalisation there is now a strong pressure on educational and institutes to adapt to the newly gained communication standards and requirements.

While in the past decades the implementation of modern information technologies were meant to substitute existing teaching and learning methods, current tools enable new possibilities of which some have yet to be discovered.

Software tools are used as substitutes for practices, which did exist before the introduction of IT:

- Powerpoint, video- and podcasts, simulations, etc.
- Feedback systems
- Online course notes
- Student / teacher interaction
- Online tests

In the past, teaching and learning was run in a controlled environment, based on authorative structures. The teaching process has been certain and linear fixed to preset curriculae. Due to ICT turning into standards, interaction in teaching and learning become democratic and decentralised. The growth of information lead to a suspended certainty and to chaotic structures, making the development of new skills in information management essential for teachers and students [“The ICT impact report”, A.Balanskat, R.Blamire, S.Kefalla, 2006].

The change in students needs leads to the change in approach to the following:

- teaching and learning
- authority and ownership
- command and control

The aim is to address the new habits, attitudes, expectations and abilities of students.

Samples of Techniques

Changes do not only occur in software and growth of information, but also in multiple devices which now grant mobile access. Web based supported collaboration became already a standard in professional life. Due to those rapid changes and developments in ICT applications, it is difficult to provide a precise description of available software and tools. In the recent years the period in with an ICT aplication turns into a general recognised standard is getting shorter and shorter. Thus the following list of available methodologies is given without a direct refernce to actual software products:

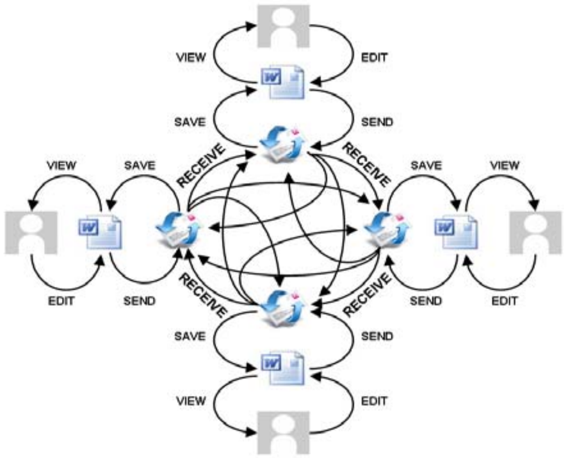
- Social networks
  These are internet based communities that commonly produce, publish and share user generated content. Most LMS (learning management systems) could also be described as social networks with firm authorative structures, where the production and publication of content is limited.

- Wiki projects
  Wikis are websites which are used to enable collaborative generation and edition of content on any number of interlinked web pages via a web browser using a simplified markup language. Wikis are often used to power community websites, for personal note taking, in corporate intranets, and in knowledge management systems [wikipdia.org].

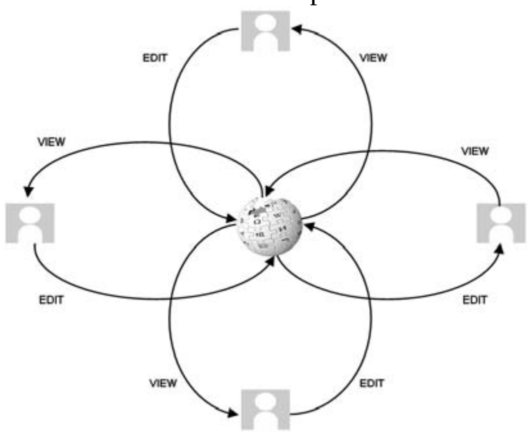
  Wikis are not only used as archives but also to enhance team collaborations (see Figure 7). Instead of circulation of documents via email, all participants ar able to gnerate or edit a document and discuss the made changes on connected forum style sheets.

- Open online courses
  Course materials in a virtual learning environment which are created by universities and shared freely with the world via the internet and resemble open online courses. Among one of the first universities, the University of Tübingen in Germany published videos of lectures on the internet in 1999 [timms.uni-tuebingen.de]. Since then, a great number of universities have created open coursework projects.

- Micro- and Mobile learning
  Mobile internet devices serve as tools to learn in short modules. These short modules allow an individual student-centeric learning. Based on the ability of self-centered learning manangement, several microlearning applications enable an evaluation based on automatised adaption to an individual learning approach. Examples of microlearning are quizzes, podcasts or short educative videos.



Email based cooperation



Wiki based cooperation

Figure 7: *Work process comparison Email vs Wiki*

- Edutainment
  By combining entertainment and education, the efficiency and motivation to learn is supposed to be increased. There are several forms of edutainment like *Teach-Tale-Tainment* and *Infotainment* where information is transported in a narrative tale like form, and *Tooltainment* which resembles applications that support the student in a creative learning process. Games are used in *Skilltainment* in order to support the devlopment and training of specific necessary skills. *Simtainment* is nowadays the most commonly used form of edutainment in civil engineering education as complex processes are explained in simulation programms.

Current developments due to ICT

To estimate the impact of an application in teaching and learning it seems to be of importance to focus on current developments and trends of new technologies. New applications may quickly grow to become a commonly shared standard (e.g. internet search engine: google.com, online encyclopedia: wikipedia.org) after a certain period of time. ICT trends usually start out with a community of younger generation users and quickly expand to older ages. The social network facebook.com for example started in 2004 and now currently has 59 million users - and 2 million new ones joining each week.

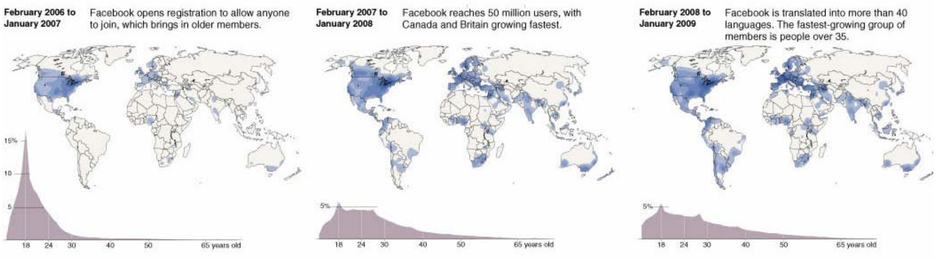


Figure 8: *Global development of Facebook users* [Facebook.com]

During the work of EUCEET II, which took place before 2005, the internet and its applications were already undergoing major changes which have been described as the transition from a so called Web 1.0 to Web 2.0.

Web 2.0

At the beginning of this transition, websites had been produced and content published online only by a small elite. After the year 2000 new software and dynamic html started to facilitate an easy creation of websites and allowed a much bigger crowd to publish their content on the internet. Websites turned from static single dimensional information (passive viewing) to dynamic pages with user interactions.

Thus the term "Web 2.0" (2004–present) is associated with web applications that enable interactive information sharing, user-centred design, interoperability, and collaboration on the Internet. Web-based communities, hosted services, web applications, social-networking sites, video-sharing sites, wikis and blogs are typical examples of Web 2.0 applications. These tools allow their users to interact with other users or to edit and enrich the websites content.

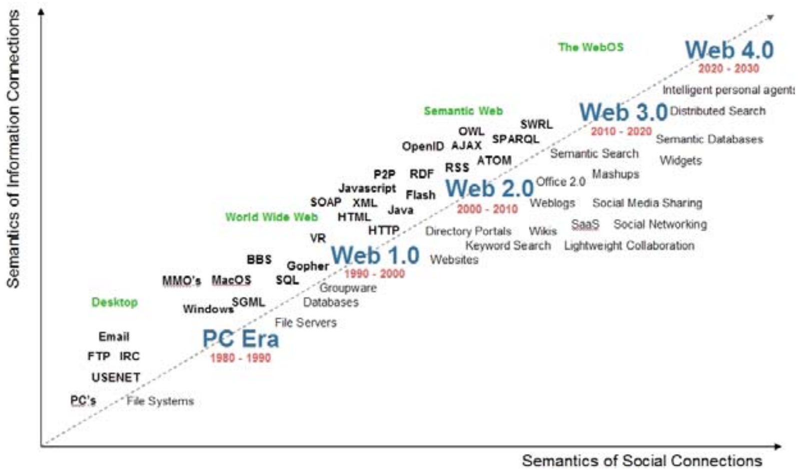


Figure 9: *Key technologies and application in web development* [radarnetworks.com]

Web 3.0

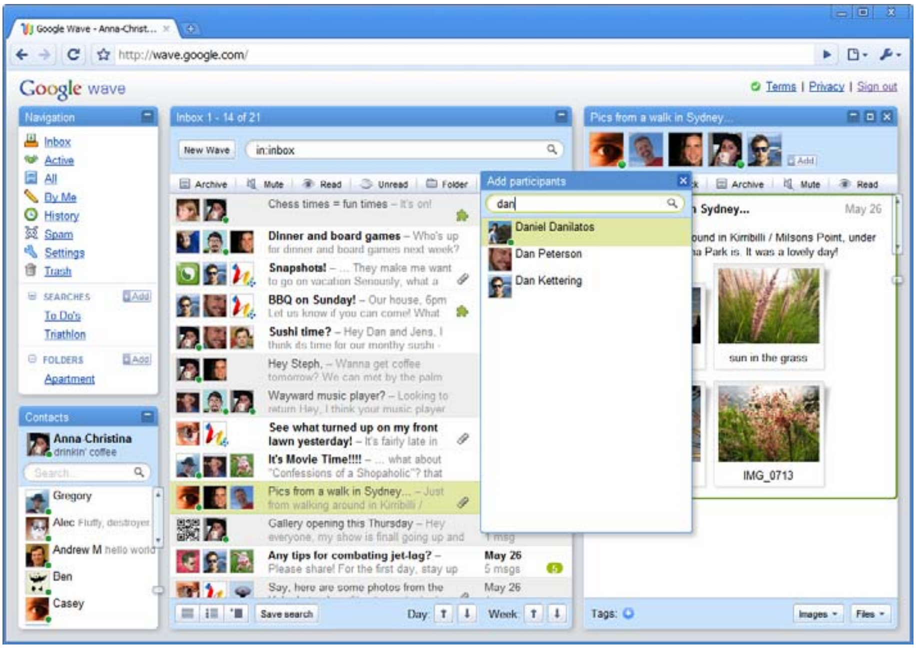


Figure 10: *Sample screen of Google Wave* [wave.google.com]

Recently there is a trend to initiate the so called Semantic Web, which is an evolving development of the internet in which the meaning of data and services is defined, enabling the web to process and comprehend the requests of people to use online content. The semantic web is described by a set of design principles, collaborative working groups, and a variety of enabling technologies. Some elements of Web 3.0 are expressed as prospective future possibilities that are yet to be implemented or realized. Due to the fast expansion of the digital universe, Semantic Web applications, as well as innovation and renovation of information content technologies are currently experiencing intensified interest.

As an example of an application towards a Web 3.0, Google Wave (see figure 10) is a unified communications platform. The web based tool is basically a container combining email, instant messaging, photos, video and live document sharing in one single place. A wave consists of a collection of interactions, documents and rich media, not being limited to the Google Wave platform, but can also be used as an embedded wave technology in a blog or web site and have the same functionality as inside the program interface.

So far Google Wave only provides a cloud-based, fixed ontology, open-source communication object framework enabling various possibilities with a potential to become a base for semantic technology in the near future.

USING E-ASSESSMENT AS PART OF BLENDED LEARNING

AJ Smithies and Ask Kwan[2]

ABSTRACT

Education in Europe, including university education, has recently gradually moved the focus from "teaching" and "teacher-centred-teaching" to "learning" and "student-centred-learning." It is argued in this paper that provision of the environment for student-centred-learning in modern European universities should take into account changes in technology, and in the nature of the student, as well as a growing trend among new engineering students in universities lacking the learning skill to adapt and respond to traditional university teacher- and/or curriculum-centred teaching. Whatever the actual reasons, and even if some students are able to adapt to university teaching well, it is proposed in this paper to use a highly adapted form of e-assessment to promote and enhance undergraduate learning. Two instances of this approach have been trialled. The trials and subsequent results are discussed. The conclusion is that Year 1 students on the whole are very much in favour of such a learning tool for mathematically based subjects.

Keywords: *e-Assessment; learning incentives; shallow learning; Articulate Quizmaker*

1. INTRODUCTION

Clearly, major changes have taken place across continental Europe arising from the Bologna declaration. In many instances, this has also led to an in-depth review of the curriculum, a downsizing of what is considered core material, and some changes to the nature of material delivery. However, non-Bologna induced changes have also taken place, e.g. curriculum evolution, change in level and sources of funding, changes in learning technologies and also evolvement of pedagogy. Most fundamental of all though, it is argued here that the nature of the learner has change to the extent that sole use of traditional university teaching methods are no longer sufficiently effective for the typical new students. In the UK, there has been almost a continuous debate over a decade on whether school leaving examination results have had a gradual inflated, or whether the examinations have gradually become easier. Within

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engineering and allied subjects, the concern is usually more directed on the mathematical ability school leavers, which eventually led to a 2004 UK Government study [1] that concluded “we have a curriculum and qualifications framework that fails to meet the mathematical requirements of learners, fails to meet the needs and expectations of higher education and employers and fails to motivate and encourage sufficient numbers of young people to continue with the study of mathematics post-16.”

While attention is understandably focused on the level of understanding of the subject among school leavers, what is perhaps even more grave is the way teaching, and therefore school learning, has changed – and arguably from changing national policy on assessment and testing. In 2006, the UK Government House of Lords’ Science and Technology Committee stated, in the *third* paragraph of a 297-page report [2]: “We are deeply concerned about the impact that so-called ‘teaching to the test’ is having upon the quality of science and mathematics teaching.” If students are ‘taught to the test’ then their learning will accordingly be determined by the assessment. What they choose to learn will be determined by what will be in the examination, and how they learn it will be determined by how they will be examined. If students arrive at universities having all their learning lives been brought up with and accustomed to a “shallow” or “surface” learning approach (see e.g. [3]) then it is not surprising that they, at least initially, expect all the learning conditions and stimuli they have been hitherto accustomed to; they would expect learning at university is about gathering information, un-inquisitively accepting what is given, reproducing what is shown, learning only what is taught, and being motivated by examination results.

Traditional university learning and teaching do not promote shallow learning, but rather, deep-seated and profound learning. Traditional university assessments do not reward mere reproduction of the standard or what the teacher has given, but what the student has gone on to independently synthesise, apply, hypothesise, test, and conclude. Furthermore, the large classes in universities, and especially so in the lower years, do not allow close teacher attention of the student as required and perhaps expected by the shallow learner. Students are thus initially perplexed and probably overwhelmed by their new learning environment. A few students would actually detect their changed environment and quickly adjust their learning approach. The majority would gradually do the same over a period of maybe a year or two, but some would never be able to adjust despite having previously been “successful” students in school.

If students now arrive at universities predominantly as shallow learners, it is through no “fault” of their own and should thus be helped to adjust. If students are knowingly accepted into university as shallow learners, and universities accept financial remuneration for educating these students, then universities should help the students to adjust. Clearly, universities cannot merely switch to promoting shallow learning, since the goal is still produce graduates who are independent life-long learners, valued by industry and the business world as future leaders who can adapt to change, be creative and self-motivated, and solve new problems. It is thus argued here that there should be a graduated approach to the design and delivery of university engineering degree programmes, such that allowance is made and help is provided for students in the lower years who have to be "weaned off" shallow learning.

How the weaning help is provided, and on what, is thus a clearly important issue. Although different universities have naturally different emphases on what is contained in a Civil Engineering degree, there is nonetheless a typical approach as shown in Figure 1, whereby a general and foundational material (*e.g*. mathematics, elementary mechanics, enabling and fundamental skills) are treated at the start of the degree; see triangle A in Figure 1. This material is usually reinforced and embedded in practical applicatory tasks such as laboratory or design exercises. Over time, there is a gradual transition of the curricula which both broadens the civil engineering student (*e.g*. with business, management, professional ethics) and deepens understanding with advance research-led specialist subjects (*e.g*. fracture mechanics, nonlinear dynamics); see triangle B in Figure 1. The mathematical subjects in triangle A are thus ideal candidates where weaning help can be introduced, and to this end, this paper details a trial conducted in the Year 1 Structural Mechanics module in Cardiff's Civil Engineering degree programme.

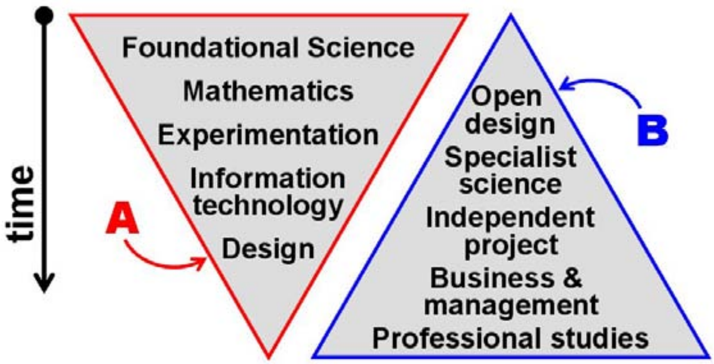

Figure 1. Transition of curriculum nature with progression in a typical engineering degree.

2. THE ROLES AND TYPES OF ASSESSMENT

Having identified the presence of shallow learners in early years of the engineering degree, and the need to wean them onto deep-seated learning, there remains the necessity to find an effective mechanism. The effectiveness has to be on two counts: it needs to be effectual in promoting active learning and also efficient in the use of staff time. To this end, it is observed that one of the more influential incentives in shallow learning is assessment and the potential reward of gaining marks, and some form of automated online system would be a very efficient use of time.

Assessments are usually classified under the broad headings of "diagnostic", "formative" and "summative" where a diagnostic assessments is primarily to inform on prior knowledge of the learner (both for the benefit of the learner and teacher), formative assessments are assessment tasks prior to the end of a learning unit (a module or a course) which are designed to provide feedback to the learners on their progress so far, and summative assessments are meant to be the final assessment task(s) intended to grade the learner. Electronic assessments are reckoned to be ideal for diagnostic and also formative assessments, but are less used in engineering summative assessments (where e-assessments are usually deemed currently not sophisticated enough to uncover all the subtleties and intricacies associated with a typical engineering examination or major assessment).

It is often argued that formative assessments should not count towards the final grading, but in practice, formative assessments would not be attempted (and hence allowed to be formative to a student) unless it is compulsory and carry some grading percentage. Equally, the formative nature of summative assessments should not be underestimated in providing feedback for follow-on modules. The actual distinction is therefore often not as sharp as portrayed in the literature. Furthermore, it is proposed in this work to introduce another heading of assessment where the primary purpose is not actually assessment but learning. There is already threeway relationship between teaching, learning and assessment (*e.g.* see the concept of "constructive alignment" [4]), whereby feedback from assessment informs the learner (and teacher). This concept is now taken beyond its normal boundary in that the mechanism of assessment and associated feedback is deliberately exploited in a multi-stage enhanced learning exercise. This approach is subsequent called EAL for short and the tool is described in Section 3. Although the students might perceive the EAL as assessment (since some marks are still awarded) the undoubted benefit is the learning that takes place during and as a result of taking the exercise.

3. The EAL (E-Assessment as Learning) TOOL

Before the EAL-Tool is described, its salient points are hereby listed.

1. Using the framework of "assessment" and hence containing the extrinsic motivation factor to engage students applying shallow learning.
2. Using an electronic platform for delivery, thereby availing itself to all the benefits associated with e-learning (*e.g.* "anytime-anywhere," multi-sensory, repeatable, *etc*.)
3. Using the form of e-assessment, thereby providing instantaneous marking and feedback, automated recording of marks, easy accommodation of large classes, and easy re-use in following years.
4. Using a multi-step approach, which is both suited for elementary mathematical / mechanics subjects but also an essential feature for students used to shallow learning (where learning is conducted in "bite-size chunks" – i.e. small easily digestible individual parts).
5. Use of a predetermined flow path which does not allow students to opt out or skip any part, and in which progression to the next stage is dependent on the successful completion of the current stage.
6. Use of "intelligent feedback" so minimal feedback is provided if the correct answer is supplied at a stage first time, but more feedback and even finer breakdown of a stage is given when a wrong answer is supplied. This allows a student who knows how to do the exercise to fast-track through without becoming tedious, but at the same time allows students who need more directed guidance to receive help.

3.1. The "Articulate Quizmaker" software

The EAL-Tool was compiled using the software package Articulate Quizmaker '09 [5]. A similar and equally applicable software package would have been Questionmark Perception [6], especially if it was combined with Adobe Captivate 4 [7]. The key factors which led to Quizmaker '09 were range of types of questions, ease of use in setting up and editing questions, and the ability to have everything the learner need to run EAL-Tool on their computer delivered with a single "black-box" package via just a web-browser (using Flash-technology). Another important factor was that output from the resultant EAL-Tool can be monitored a suitable (SCORM-compliant) Virtual Learning Environment (*e.g.* BlackBoard, or Moodle), via the Articulate Online webserver, or via email updates. This allows the teacher a comprehensive live at-a-glance view of the level of understanding of the class, as well as more detailed view of how individual students understand specific elements of the course. Figure 2 shows the Quizmaker software, with its fairly intuitive simple-to-use interface for question building.

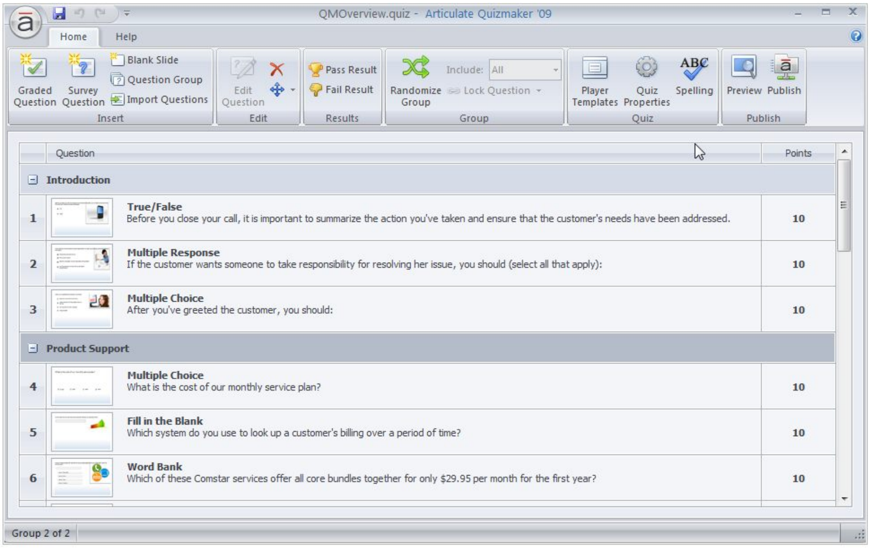

Figure 2. The Articulate Quizmaker question building interface.

The four most commonly known types of questions for online assessments are “multiple choice”, “true or false”, “fill in the blank” and “numeric answers.” While these are incorporated in Quizmaker, it is argued that the first two types are of limited use in the EAL-Tool, since students can without much difficulty guess the answers and thus opt out of the learning. A more testing form of “multiple choice” is the “multiple response questions” (in Quizmaker) where a learner has to provide more than one correct answer before proceeding to the next stage. Another useful form of question is “hotspot” where the learner has to identify a point on the slide where the answer is to be found; this facility is useful for engineering our answers can be pictorial, graphical or in equation format and Quizmaker has limited equation handling capability so more complicated equations can be imported in as graphics. Other useful question types provided in Quizmaker are “word bank”, “matching drag and drop”, “matching drop-down”, “sequence drag and drop” and “sequence drop-down.”

One of the perceived drawbacks of online assessment is that it limits learner creativity and the answer has to be provided within the narrow format preconceived by the teacher. While this is true, and this can certainly preclude online assessment for more open-ended exercise (*e.g.* design of a retaining wall), it is not relevant for the EAL-Tool which is targeted at mathematical subjects in the early years where there is naturally less scope for open-ended questioning. What is more important in the early years is for the student to learn get fundamentals correct, and have a good understanding of the reasons for those fundamentals, and having to follow preconceived tight format in multiple stages is actually a beneficial and effective approach.

3.1. Two trials of EAL-Tool using Quizmaker

Two trials of the EAL-Tool have so far been conducted with Year 1 Structural Mechanics students. The first exercise involved getting students to work out the bending moment, shear force and thrust diagrams of a three-pin frame structure as shown in Figure 3. The second EAL-Tool exercise was on a more complicated problem, where a cantilevered thin tube was loaded axially, in torsion, and by internal pressure, and the resultant stresses along given crack was to be determined via a Mohr's Circle of stress (see Figure 4); this second exercise was purposely designed to be even more multi-staged.

For each trial, the principal difference between an EAL-Tool slide, and any other online assessment slide, is that the foremost purpose in mind during the designing of the questions is in the learning that can be gained, and less so in the testing of what the learner knows. The "questions" therefore are often surrounded with supporting information. Whether a question could several steps in the answer, the question is then broken down into multi-stages so that each sub-stage builds upon the previous stages so that the information on screen gradually builds up.

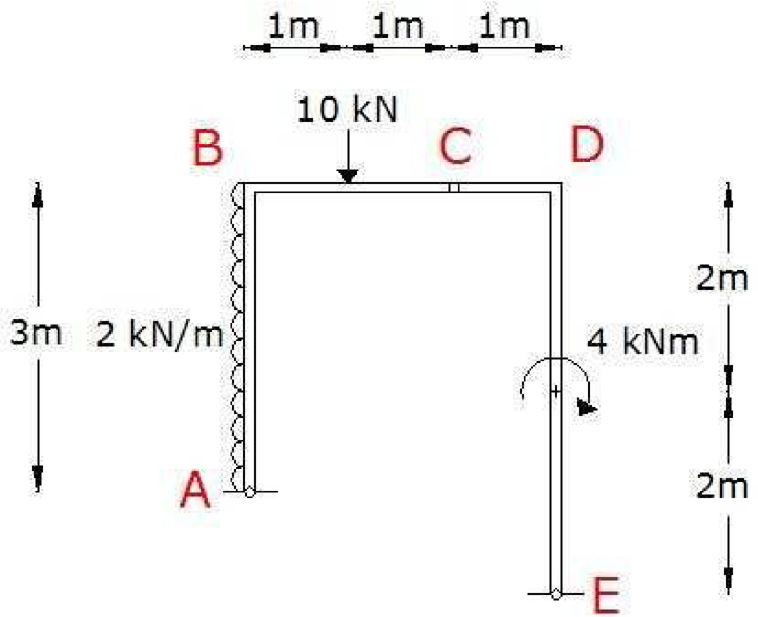

Figure 3. The frame structure used for trial one of the EAL-Tool.

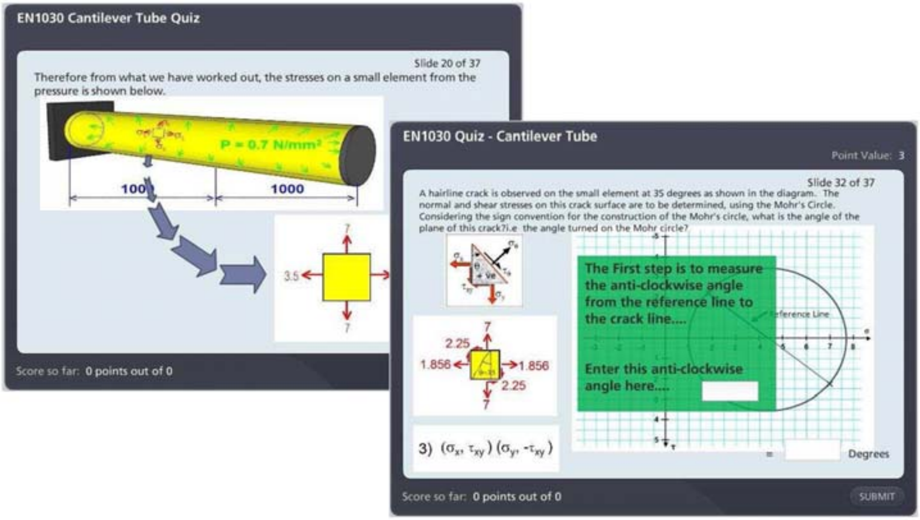

Figure 4. Screenshots from the second cantilevered tube EAL-Tool trial.

The second trial included several features not in the earlier trial. Narration was added to mere text and the amount of text in any one screen reduced (this was a useful change for dyslexic students), diagrams were made more engaging (by being drawn in 3D perspective view where this was helpful) and in colour, some animations were used, more branching was introduced to allow different levels of questioning and feedback when the learner get a question wrong, more numeric answers were required (to minimise guess-work) and different amount of marks were awarded for needing more than one attempt at answering a question.

In additional and prior to the two EAL-Tool exercises, the same group of students also had a conventional one-hour long examination-condition test where they had to answer similar mechanics questions on paper, perform calculations, work through equations and provide numeric answers. The students thus have had a good benchmark with which to compare their EAL-Tool experience.

4. FINDINGS

For the first trial, students were asked about their confidence/knowledge in dealing with the questions before and after the EAL-Tool (1=very low, 10=very high), see Table 1. Although the students scored themselves quite highly beforehand, the scores they assigned themselves still increased afterwards, which showed they thought the EAL-Tool was helpful.

Table 1. Student perception before and after using the EAL-Tool

	Before	**After**
Confidence in dealing with BM equations	8.07	8.49
Knowledge of the subject matter	8.03	8.39
Confidence in dealing with BM, SF & T diagrams	7.29	8.48

Students were asked specific questions about their opinion of the first trial, partly to see how they responded and partly to see what changes should be made for the second trial. Clearly, the results (questions 2 and 3) show students thought the EAL-Tool was useful as a learning tool, and more beneficial than a paper test (question 6), although a minority of students did prefer a paper test (Q 9). Many thought both types together would be good (Q 10). The highest scored question (Q 11) showed students actually thought reviewing the EAL-Tool later on (when there would no longer the incentive of gaining marks for doing the exercise) would be a good revision tool, and hence they clearly valued it learning tool.

Table 2. Average score of 132 student responses to specific questions

	Score
1. The quiz was set out well	8.75
2. Quiz improved my knowledge on how to determine the 3 diagrams	8.76
3. The online quiz has helped confirm my knowledge of the topic	8.54
4. The steps within the quiz are too advanced	4.33
5. The steps within the quiz are too simple	5.02
6. The quiz has been more beneficial than a normal paper quiz	8.30
7. This quiz has tested my knowledge of the topic sufficiently	7.63
8. The flexibility of when to undertake the quiz is beneficial	8.31
9. I prefer the paper test structure rather than this electronic quiz	3.67
10. Electronic assessments would go well in addition to paper tests	7.83
11. This quiz would be good revision material for end of year exam	9.07

Students were also allowed to submit free-format opinions of the exercise, and their comments were 128 in favour and 4 against. The negative comments were about not liking to watch a screen and not liking the multiple choice format of questioning. Most of the positive comments were of general nature (e.g. “it was helpful” 22x; “improves understanding” 21x; “improves knowledge” 14x) but some students commented on the usefulness of having the time to think about the exercise, the flexibility of it being online (19x), and the usefulness of the multi-staging (15x) and that the online testing helped to confirm knowledge (*i.e.* providing feedback on how well or not they understand something). Some students even thought it was "fun"!

The free-format textual results from the second trial was very similar to the first but students were asked to give the worst aspect of the exercise. Some students said "nothing" but the most common answer was the computer speed of the exercise, followed by the inability to just skip a question. The proportion of positive to negative comments, and their nature, were still about the same as for the first trial, but students now provided more details in their comments. Students were specifically asked about some features which had been introduced for the second trial, and Table 3 shows their answers. Students were generally appreciative of the changes (though providing a narration was probably wasted effort for most students) but the most important aspect for the students was the branching whereby a student was taken to further depths and provided more feedback when they get a question wrong.

Table 3. Student responses to specific questions on the second trial.

	Score
1. The colour coordinated text and diagrams	7.9
2. Audio throughout the quiz	6.8
3. Moving visuals	7.7
4. The feedback after you get a question correct	7.7
5. The feedback after you get a question wrong	7.5
6. The branched questions where if you get a question wrong, you are directed to a break down of that question	8.4
7. The different point scoring of the quiz	7.8

5. CONCLUSIONS

Although only two EAL-Tool trials have been conducted so far, the results have been encouraging. There is a lot of scope for further trials, and in other subjects, but even with the limited trials so far, it can be concluded that e-assessment can be manipulated into a very successful learning tool for students in the early years of an engineering degree.

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DEVELOPING BLENDED LEARNING IN CIVIL ENGINEERING

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SUMMARY

Education in Europe, including university education, has recently gradually moved the focus from "teaching" and "teacher-centred-teaching" to "learning" and "student-centred-learning." It is argued in this paper that provision of the environment for student-centred-learning in modern European universities should take into account changes in both technology and in the nature of the student. There has been much development in eLearning initiatives (typically internet-based, and typically freely available) that means it is neither very difficult nor costly to supplement the physical (i.e. traditional) learning environment with eLearning provisions, which is the "blended learning" advocated in this paper. This paper covers the more readily deployable solutions of a virtual learning environment (VLE), online collaboration, multi-media provisions, and some aspects of e-assessments.

1 INTRODUCTION

Recent major changes in university education across Europe have certainly generated much debate on the wisdom or necessity of those changes. However, the implementation of those changes have also provided a welcome forum for wider discussions of a more fundamental nature, such as the change in the make-up, disposition, knowledge and skills of the undergraduate student today compared to say that of ten years ago, and how those differences impact on university learning and teaching [1]. At the same time, there has been a growing emergence worldwide of eLearning at all levels of education, and there is often some desire in engineering teachers, if not the expertise and time, to implement some eLearning in their own courses.

Although the authors have principally UK (and German) experience, and thus speak from that perspective, the pressures on European universities in recent years have been broadly similar. Over the last decade or so, students have increasingly found the transition to higher education difficult. In engineering and allied subjects, this has been attributed to the mathematical preparation in primary and secondary education [2, 3], as well as the difference in teaching style in higher education. Some of the potential causes have been thought to be the discrepancy between higher education institutions' expectations of students and students' expectations of higher education. This can cause both student and staff frustration [4]. It is proposed here that a blended learning approach can help, from two perspectives.

The first perspective is that of expectation. Of the many differences in the modern student, one important one is that the student is not only far more computer-literate, and very likely to have a high-power laptop with mobile internet link, but will also have extensive experience of the internet for many social and entertainment reasons. The student would also be highly accustomed to looking for online information from the mundane (e.g. the local bus timetable), or the highly specialised (e.g. the Fischer-Tropsch process for synthesising hydrocarbons), for both social and work reasons. As these secondary school students advance into universities, which are seen as the pioneering centres from which future technologies emerge, it is not without justification that the students might expect their learning experience to also equally advance into more even groundbreaking use of technology and the computer than they have hitherto been accustomed to. When they arrive at university, this expectation is not often met, and the purpose of this paper is to show some simple and economical measures that can make a significant difference.

The second perspective is that of expediency. Some of the consequences of incoming students having a more diverse academic background is to provide additional supplementary and transition material to cover knowledge gaps, to refresh skills, and to re-contextualise things already learnt within the settings required for engineering study. Very often, this is with additional classes (especially for mathematics) and work-books, but staff time for extra provision is clearly limited. Teacher directed self-leaning with web-based material is both effective for the student, and expedient for the teacher. General provisions for school mathematics like the free MathCentre [5] or MathTutor [6] show what is possible and also provide a good model for engineering tutors to emulate with their own more specific subject material.

It should be noted that what is advocated here is not distance learning, or a correspondence course. There is much to be gained by physically attending an education centre of excellence and interacting with the teachers and other learners, which can never be somehow packaged and distributed online. Therefore, successful blended learning is about adding value to the physical onsite experience, by extending that experience with a modern rich and immersive learning medium unconstrained by the physical boundaries of the campus or the working hours of the teachers. The rest of this paper shows some easy to achieve techniques towards creating a blended learning environment.

2. VIRTUAL LEARNING ENVIRONMENT (VLE)

With the ubiquitous use of internet for information, it is natural to expect university modules or courses should also have a presence on the web. A web-system that helps faculty teachers to manage such a presence is usually called a “virtual learning environment (VLE),” or “learning management systems (LMS),” or “course management system (CMS)”. The nature and the extent of use to which such systems are put vary, but at the very simplest (and the most widely used level), the VLE is an electronic cupboard of course notes – i.e. it allows the teacher to provide and update, and the students to retrieve, notes and information, and both from anywhere, and at any time. So long as the course notes are already in an electronic form, and the teacher is agreeable to making it so readily accessible, then at the very least, such a use of an electronic depository allows both teachers and students quick access to shared content without the constraint of physical location. It also removes the need for reproduction, storage and potential wastage, of paper-based information. Unless the VLE is no more than a simple open-webpage (or FTP site), there is usually also some control of access especially for uploading of material. Most VLEs also allow managed access, for example, pre-programmed release of material to all users at a certain date, or selective staged release of material where only users who have complied with certain conditions, e.g. successfully passed an online assessment, or previously viewed some other material, can have access to subsequent material.

Many universities have already installed VLE systems that provide a standard template layout for teachers so that uploading is a simple login followed by a few clicks to locate the file to be uploaded. At the same time, a number of freely available (open-source) alternatives exist. A simple search on the internet for “Moodle” [7], “ILIAS” [8], “eFront” [9], “Sakai” [10], or “Dokeos” [11] will reveal much information and sources of free VLEs. Some of these will host the material so a registered teacher merely uploads and need not have any concern about server maintenance, etc. Some will also allow the software to be downloaded so a teacher can install and customise the VLE system on his or her own server.

Apart from being merely an electronic file transfer system, most VLEs have many other useful features to enhance the learning experience. They typically include some means of electronic communication like email list of users of a module, and electronic discussion forums so students (and teachers) can exchange information or ask/answer questions relating to the module. A useful feature for the teacher in answering a question in an electronic forum is that the answer is then archived for, and searchable by, future students; the forum becomes a growing shared knowledge base for everyone.

Similarly, VLEs more recently have also tended to include wikis, blogs and podcasting tools to allow all users to be not merely passive readers and but active participants. This aspect of learning is particularly useful when the class size is big and the normal contact time in the module is a traditional lecture in which the students are expected to be silent recipients. It is well known that learning is reinforced and enhanced when students have to actively participate, e.g. in a group discussions or a seminar, but large classes do not allow students the means nor the conducive environment for expressive participation. Facilities like forums, wikis and blogs (and they are sometimes evaluated and assessed to encourage engagement) not only permit important student interaction to improve their own learning but also to cultivate a culture of peer-assisted learning, and foster something of a shared community even when the student number is large and they are physically distributed. It is also true that the phenomenon of online social-networking has bloomed in the last two to three years so that school and university students are accomplished frequent users of websites like “mySpace” [12] and “facebook” [13] – it is obviously desirable that students conduct their “online life” not just for social networking but also for learning networking, and that is potentially not just with other students on their own course, but also with students in other universities across the world studying the same subject.

Emails and forums are forms of asynchronous communication, which has the main advantage that participants can access and contribute to the communication at a time of their own choosing. Some VLEs also allow some form of synchronous distributed (i.e. same time, different location) communication, for example with “instant messaging” and “whiteboarding”; this is further discussed in Section 4. VLEs also typically have some facilities for online assessments, which is the subject of Section 5 below.

3. MULTI-MEDIA PRODUCTIONS

Most files made available to students as notes are typically textual documents, or slides from a presentation file. Some teachers would provide the raw files while others convert them into .pdf format, both to ensure the students view the file as intended by the teacher, but also to a certain extent, protect information rights of the content. Although electronic availability of static content files is useful, the nature of engineering is such that many explanations are best conveyed verbally, through a demonstration. Students today are also far more accustomed to media-rich web content so that although a static web page might contain exactly the same information, yet the student is better attuned to a dynamic web page and can even subconsciously expend more effort to learn when presented with dynamic material. The educational/instructional value of video sharing websites for the modern computer-infused generation should not be undervalued. It is also true that many engineering concepts are actually dynamic and are thus best described through a dynamic presentation (e.g. video clip or computer animation). Often, even static concepts (e.g.

direction and distribution of shear stress in a universal beam) can be better explained and visualised through some form of a 3D dynamic presentation.

The main difficulties with producing animations and video clips is that the process is time consuming and need specialist skills not normally found in engineering teachers. However, there are simple software packages that allow dynamic computer screen capture and at the same time record an audio clip using either the laptop microphone or an external microphone. Camstudio [14] is a free package, and Camtasia [15] is a commercial equivalent, and both run from a standalone computer. Both would produce computer video clips (e.g. in .swf, .wmv, or .avi format) with post-recording processing capabilities (e.g. adding text labels on screen). Once the capture program is set to run, it records quietly in the background the screen output and the microphone input, until the recording is stopped. In this way, a teacher can record short audio-visual clips or even whole lectures, and these can be uploaded within a fifteen minutes after the event with very little effort.

Some university have also installed campus-wide automatic recording of all lectures, which may be just the screen capture and the audio (as above), or it could include additionally a video camera feed to show the lecturer, and a visualiser (a camera-based device similar to the overhead projector) feed. The camera feed can be useful in classes where a physical model demonstration is shown, which would not be captured on the computer screen (although a simple webcam could also used, which is especially useful when the object demonstrated is actually small and thus difficult to see from the back of the class). Although the principles involved with such large-scale installations are the same, clearly they are a much more costly option.

A very useful (and inexpensive, around €50) tool to really enhance computer screen capture recording is a tablet device or a pen-input device. This is simply a small pad (typically around 15x20cm) which connects to the computer via a USB port, and is sensitive to a special pen. The device works as a mouse input, and is a very inexpensive device to provide hand written input to a computer screen. Microsoft-Powerpoint (version 2003 onwards) in presentation mode actually allows these hand-written annotations (with choice of multiple colours and pen types) which not only appears on screen but can also be saved afterwards. In this way, a teacher can use the pen-input device as an annotation or writing tool for a prepared lecture to highlight or reinforce aspects of a slide, or as an electronic alternative to the overhead projector by writing on blank slides, all of which can be recorded with voice comment at the same time. Even when no recording is made, the advantages of using this arrangement over the traditional overhead projector are: an electronic copy of the written notes is immediately available for archive or distribution to students; the erase function allows very clean erasing of mistakes; there is near-unlimited number of blank slides available; there is never a problem of running out of ink on projector pens; and the projected image from a computer projector is often far better aligned with the physical screen (since it has keystone adjustment.)

The disadvantage of a pen-input device is that it is unnatural to write on a pad next and nothing shows up where the tip of the pen is (i.e. on the pad), but the writing actually appears elsewhere (i.e. on the computer screen), though experience has shown that this is a simple skill that can be honed in a matter of minutes.

3.1 Lecture recording

An obvious and simple application of the recording arrangement is in the recording of lectures. Where a lecture is already delivered using computer projection, there is very little additional effort to actually record it as well. The teacher merely switches on the recording beforehand, and everything that is shown on screen during the lecture (which includes, e.g. software demonstration, video clips, etc. and not just the lecture slides themselves) is recorded. After the lecture, the recording file should be processed (compressed and resolution lowered) so that it is more download friendly. An hour of lecture on 400x300 screen with a medium (discernible but entirely acceptable) level of compression occupies typically only 25Mb. A student can thus store, and replay at any time on-demand, around three years worth of lectures on a mobile phone with video capability that is already available in the shops.

3.2 Audio-Visual (A-V) clips

If lectures can be easily recorded for downloading, then additional short clips can also be equally recorded. While this might seem like additional work, there can in fact be an overall saving of work, because such a clip can be provided in answer to a specific student question, and once stored, it is then the answer to that particular question which can be asked by other students, and students in subsequent years. A store of such audio-visual clips in fact becomes a video equivalent of the “frequently-asked-questions” for a course. Students can be directed to first search this store before they actually ask their question (which would save the teacher time) and where the store is extensive, students would indeed prefer to first search the store because they are likely to find the answer there very quickly and long before they get to see the teacher. Clearly, in addition to answers to student questions, a teacher can also provide supplementary material to a lecture course, whether it is bridging material (to help students on the course with a non-standard background), reinforcing material (e.g. a worked solution to illustrate the application of some theoretical development), or subsidiary material useful for the more searching students but not actually necessary for whole-class presentation.

3.3 Findings of a student-survey

A trial of lecture recording in Cardiff University for two groups of students (and and A-V clips for one of them) has been conducted. They were both structural mechanics classes but one was a large (approx 150 students) Year 1 class and the other was a small (approx 15 students) Year 4 class. Both classes were surveyed and the sample size was 61% and 80% respectively.

On a scale of 1 to 5, the Year 1 students rated the lecture recording *usefulness* at a high 4.41 (4.28 for A-V clips), while the Year 4 rated it at 3.50. However, but for actual *usage*, Year 1 rating was 2.80 and 2.75 respectively (where 3.00 equates to watching about half of the recordings), and Year 4 usage was only 1.80. Although the recordings could be downloaded (5.00), or watched online (1.00), usage was about equally split for both sets of students (2.32 and 2.56). Both sets of students also tended to not watch recordings from beginning to end, but tended to stop, rewind and replay segments (4.01 and 3.13).

The students were also asked that, if they had used the recordings, why they used them and how they were helpful or not, and how recordings could enhance learning (or not). The most frequent replies were: useful to go over again something not understood in lecture (42x); good for revision, reminder, re-visit material (25x); useful if they missed a lecture (23x); good for catching up/filling in missed bits of lecture (16x); allowed working at a student's own pace and time, with pause and repeat (13x). These answers are actually quite revealing. Even when students might not actually use the recordings all that much (e.g. the Year 4 students, and some Year 1 students) not one student expressed any negative opinion about the facility. Although one of the main concerns of providing lecture recordings is a drop in lecture attendance, this was not particularly observed in the two modules, and the ability to re-cover a missed lecture was only the third most frequently cited aspect of usefulness. By far the most useful aspect of lecture recording (for both Years 1 and 4), was the ability to go over again some aspect of a lecture that was not understood the first time round. Many students also thought the recordings would be useful for revision; this was probably prominent in their mind because the survey was conducted near the end of term, and the early lectures in the module would seem like in the distant past. Two other interesting aspects were revealed; Year 1 students sometimes had to choose between listening and understanding something, or writing it down. The availability of the lecture recordings allowed them to do both. Secondly, students did not always work at the pace of the lecture in real time (i.e. in the pace of the teacher), while the recordings allowed them to work at their own pace, pausing when they needed to, having a break when their concentration waned, and repeatedly go over some aspect until they understood it. Having the recordings may well have actually reduced staff time in answering student questions outside lecture times.

Additionally, students were asked if they had a medical diagnosis of "learning disability." Eight students declared so, and all (5.00) said the recordings had helped them to study more effectively. Clearly, in a climate where we are more aware of learning disabilities, and making provisions so as not to disadvantage such students, lecture recordings is one simple and helpful move.

4. INTERACTIVE ONLINE EXCHANGES

The process of education is one of communication, between teachers and learners, and between learners (and also between teachers). Even when the communication is formal, impersonal lecture presentation material, or course notes, it is still a communication of information. However, communication is best when it is a responsive, cyclical, two-way dialogue. In a VLE context, emails and forums are good at promoting multi-directional exchanges, but their disadvantage is that they are not truly dynamic. Even when the response rate is in minutes, they still cannot approximate the interactive exchange that a "face-to-face" allows.

Some VLEs however have "collaboration tools" and these minimally allow an audio exchange and instant messaging (IM). Typically, they also allow a webcam feed (with not too low a refresh rate) and thus real-time verbal exchanges among several users in a "virtual classroom" across an internet link is possible. Most systems are configured so that the teacher has the default broadcast control of the audio feed, but other users in the "room" can click their "hands up" icon and then be given access to speak. This protocol is usually very quickly adopted. Users also very quickly use the IM pod (which can be used to send a message to all users in the room, or to only specific identified individuals in the room) as a second, lower level communication link, which is unobtrusive. In this way, a student can send a question to the teacher while the teacher is talking, without disrupting what the teacher is saying, or to another student without disrupting other students. Another use is where a teacher has asked the class a question and they can all immediately send in their answers via IM simultaneously, without being influenced by someone else's answer, nor disclosing their own answer to other students (in case they are embarrassed by their answers being known to be wrong). Such a collection of facilities would probably be both highly advantageous and fully adequate for many subject disciplines where seminars or group discussions are largely verbal-based.

For engineering however, much of our teaching is through *showing* something, and *showing* how something is done. For this, a "whiteboarding tool" found in even freely available web-based collaboration software (e.g. "vyew" [16]) would be particularly useful. Users in a virtual room can all share a common whiteboard where they each have a mouse pointer which other users can see, and each user can mark up the whiteboard with free-hand writing and with use of simple drawing tools (e.g. line, rectangle, fill, erase, etc). In this way, users can effectively collaborate as though they were all in front of the same physical sheet of paper, each with a pen, and all talking to each other. Whiteboarding also typically allows uploading of images or presentation slides for sharing, and multiple pages in a collaborative session. Some whiteboarding tools require users to have installed the software before use, but others (like vyew) are web-based and thus can be used instantly by anyone with a (fast, i.e. at least broadband) internet link.

It is thus quite conceivable for a teacher to set up a virtual classroom, and let the students have the URL link for the room. At the appointed time, the teacher and any participating students can enter the room (by going to the webpage). Users need not establish an audio-visual link (since they can simply listen and use IM to "speak") but if they do, then a simple pop-up menu is used to select and adjust their webcam and microphone input. Thereafter, the teacher can conduct the session, allowing, prompting, or requiring as much student interaction as is desired. During the session, students can join or leave as they desired. Some systems allow recording of the session (for other students to later re-view, or for the teacher's record keeping). If recording is not integral then it is easily achieved with techniques described in Section 3. A commercial alternative to vyew is AdobeConnect [17].

Such web-based collaboration software is still fairly new and mainly targeted at corporate meetings, but the virtual classroom is also an emerging application. Collaborating tools, including whiteboarding, is beginning to be built into existing VLEs.

5. E-ASSESSMENTS

E-assessment (also called Computer Aided Assessments, CAA) is online answering and near-instantaneous marking of assessment. The aims of e-assessment are both to improve student learning by providing rapid feedback on their learning attainment and also to assist the teacher with the assessment process. When assessment is used not simply as a grading exercise at the end of the course, but during the period of the course as a learning enhancement tool, then e-assessment plays an even greater role. In a 2005 survey of 500 school headteachers in the UK, while 50% admitted to not knowing very much about e-assessment, yet 80% still agreed on the importance of the benefits of e-assessments, particularly that of teachers being able to spend more time teaching and less assessing, and that teachers themselves of getting rapid feedback on the areas of misunderstanding or weakness of the class, so that action to be taken to correct the situation in good time.

The most common and suitable form of question for e-assessment is where there is a fixed number of unambiguously correct answers. For this reason, multiple-choice questions are thus the most common form of e-assessment. Other similar formats on this premise are: “drag-and-drop” (for sorting, matching and classifying); “hot-spot locating” (identifying required features shown onscreen); “multiple-response” (selecting the set of correct items from a longer list); “true-false”; “ranking” (sorting a given list according to a given criterion); etc. Since there is an absolute correct answer to each question, it is not difficult to design a reliable test. However, these forms of assessments are too limiting for engineering teachers because they do not encourage nor indeed allow the students to provide their own answers. Unless such tests are designed well and used judiciously, they can dissuade students from higher cognitive skills required in university education. Nonetheless, when useful feedback is provided for wrong answers, and the tests are designed to be purposeful checkpoints along a calculated learning path (e.g. at the end of each small topic), they can still be a very useful learning tool for students, and a calibration tool for teachers.

The above are types of e-assessments commonly found in a VLE. The VLE provides the template for the teacher to enter the question (and answers) and the VLE administers the assessment, does the marking, and provides the feedback to both students and teachers. The VLE can also provide statistics on the test and compile the marks. This much of e-assessment is readily accessible.

Beyond this, there are specially written software for specific tasks, which can allow a more free-format input of answers but these programs are usually hard-coded for a specific topic and cannot be modified or adapted for other uses. Previously, these would be stand-alone packages (usually called CAL-packages, for “computer assisted learning”) but they now would commonly be web-based using Java applets, or a Flash applications. If a teacher requires a specific piece of software and it is not available or is too costly, then there is no alternative but to code it, or more likely, to employ someone to code it. This is not simple, quick, nor cheap.

At the highest level, answers required of engineering students are typically complex and can involve a predominant amount of mathematics and diagrams, which are difficult for a computer to assess. Additionally, many engineering problems (e.g. in design) have no single correct answer, and perfectly acceptable solutions can be obtained through more than one pathway. Given this, even when computers could be “taught” how to recognise correct answers to problems (e.g. with neural nets), it is currently difficult to see how computers can make significant inroads into marking free-format engineering submissions. Even so, there is still a significant role that computers can play in the administration of human marking of such submissions.

6. CONCLUSIONS

The present paper has argued for a blended learning approach, whereby eLearning provisions are made to extend and enhance the physical learning experience, is timely both because of reasonable student expectation and because it is an expedient solution to provide supplementary and bridging material for students who are less prepared for the engineering degree. At the same time, it has been shown that there are straightforward and free solutions (the "low hanging fruits") which can be implemented quite easily that would go some way into a truly blended learning environment.

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THEME G: Making the European civil engineering education better known and more attractive outside Europe

Report of the
Working Group

THEME G: REPORT WORKING GROUP F: MAKING THE EUROPEAN CIVIL ENGINEERING EDUCATION BETTER KNOWN AND MORE ATTRACTIVE OUTSIDE EUROPE

Report of Working Group
Carsten AHRENS[1]

1. INTRODUCTION

EUCEET [1] started as a SOCRATES Thematic Network and, according to the European dimension of the programme, tackled just European aspects of the education and training of civil engineers. After a period of two 3-year projects and an additional dissemination year it is the first time that EUCEET III "goes abroad" to making the European civil engineering education better known and more attractive outside Europe.

If one is reflecting all the results of the work groups and of specific programs of the EUCEET projects so far and as described in - all together - 6 volumes, one has to state that the European education and training programs at universities and within companies is of high quality and enables the young (civil) engineers to go abroad and to be mobile for working globally.

So, EUCEET III implemented in its project the Work Group G, the objective of which is to making the European civil engineering education better known and more attractive outside Europe. This work group G was active during the whole 3-years project EUCEET III since the founding Management Committee meeting in Vilnius, LV, 8th Dec. 2006.

2. WORK GROUP G MEMBERS AND DEVELOPMENT

The constitution of the whole work group took place in the 1st EUCEET III General Assembly in Santander, ES, March, 15th - 16th, 2007.

The core members of WG G have been appointed earlier in the meeting in Vilnius as follows:

Carsten Ahrens, chairman, FH Oldenburg (and ZDI, ECCE, WCCE), DE
Josef Machazek, CVUT Prague, CZ
Colin Kerr, Imperial College, London, UK
Thibaut Skrzypek, ENPC, Paris, FR

[1] Chairman of the Working Group for the Theme G;
Professor, Fachhochschule Oldenburg

Juris Smirnows, Technical University Riga, LV
Eivind Bratteland, Norwegian UST Trondheim, NO
Luis Garrotte, UPM Madrid, ES

The general considerations for the composition of the group have been as follows:

– Whole Europe has to be represented for the world outside Europe;
– Old and new Bologna/EU member states have to be involved;
– North, South, East, West and Middle Europe should be involved proportionally and due to the language distribution worldwide the "big" languages should be included.

Concerning the core group these considerations have been applied. The other members joined – and left – the group between and during the parallel working sessions as part of the general assemblies. All 6 working sessions of the EUCEET III period found a great number of interested participants and a lot of very helpful contributions, which are part of this final report. The list of active group members is given in addendum 1.

3. MISSION AND OBJECTIVES

The question why and how we do this type of mission in making the European civil engineering education better known and more attractive outside Europe came up rather late in the group. At the beginning everyone was really sure and convinced about this job as described in the WG G name.

Due to the difficulty to really distribute the information about European civil engineering education and training to the distinctive target groups this question has been settled and, at least, has to be answered.

The question is: What is very special in European civil engineering education?

Under this main question a number of "sub-questions" arose as follows:

Why should we do this?

- Is it self-evident that we should?
- Do we need more students?
- Can we not attract enough home students?
- Is it about attracting good people who want to come to the EU to stay and work?
- Are we proud of what we do/offer?

- Is there a single thing called “European Civil Engineering Education” which we can promote?
- Trust that we know how to produce top quality engineers?

What do we offer that is specific to us in Europe?

- Technical specialisations not available in the home country?
- Top quality teaching? If so, will our edge last? - E.g., China and India are coming up fast. -
- Harmonisation versus Diversity. Harmonisation has its place, but isn’t diversity a strength?
- Euro codes as a unifying and important theme?
- Cultural and linguistic diversity?
- Opportunity to build networks of colleagues and friends around the world?
- Better living standards? Grants, general quality of life, more opportunities?
- Is this altruism or imperialism?

How do we differ?

- Solid, accredited, professional formation?
- Educational flair and innovation?
- A preparation for tackling the new problems, such as waste, climate change, energy, new materials, sustainability etc?
- An established heritage/philosophy of education?
- Better lifestyle opportunities?
- The quality of what we offer compared to others?
- Reputation?

There is no unique and/or omni potential answers to these questions. But a short description of the European Area of Higher Education (EAHE) may help finding some kind of an answer.

4. EUROPE AND BOLOGNA

4.1 The view from outside

Europe now is Bologna concerning higher education. But Europe of Bologna now is even more: It is the European Higher Education Area (EHEA). And, what is of much more weight, it is not the EU-Europe but a cluster of up to now

46 EHEA-member states, which follow Bologna educational and structural rules [2].

By this, EHEA is a strong and highly respected educational and business partner in the economically very interesting world market of higher education. EHEA is very competitive to the US-market of education as well as to that of the ASIA-Pacific region. This is partly also true within the EHEA group, especially with respect to UK as a still residual and surviving educational island.

From outside Europe, thus from US, from ASIA-Pacific and nearly from all over the globe the Bologna-EHEA is treated as a successfully functioning education system, which obviously easily and very quickly – one decade only! – unifies or harmonizes partly the old and so much divergent higher education systems of all the different European nations. Even if the Bologna time target of 2010 is not yet reached, this is the view or picture – and partly the fear - today. It is also realized that the education and assessment procedure will be harmonized, but not the multi-national ways of educating and the variety of languages, cultures and socio-economic in the EU-countries.

The powerful SOCRATES/ERASMUS-programmes, which enabled so many European students and teachers to become mobile in studying and teaching European-wide at a partner university, also strengthened and are still strengthening this view. Especially the ERASMUS-MUNDUS-programme is acknowledged worldwide as one of the most attractive mobility programmes, economically concerning the high grants, and academically or scientifically concerning the quality of the offered common master programmes. This programme is one of the most famous and attractive programmes in higher education worldwide, because it opened the access to groups of European universities in a former unknown really phantastical manner and amount. – This programme also plays a role in answering the EUCEET question as given in the header of this paper.

The ERASMUS-MUNDUS-programme by no means is or very soon will become partner of the information society or global community system. Of course, this programme has still to be advertised e.g. via internet and has to become known by a certain amount of interested and capable students, universities and co-coordinators world-wide. But, this programme is not delivering e-learning or distance learning possibilities; is asking for personal mobility and appearance at, to and in the involved universities in more than just one European country.

4.2 The view from inside

The view from inside, of course, is a little bit different to that from outside. It is at least more objective and critical compared to that from the outside, as we all are involved in the daily work with it. On the other hand it is much more subjectively occupied, as – again - we all are involved in the daily work with it.

We all see that our old national systems, diplomas, awards etc. are becoming harmonized in the way that we have to use modules as teaching bits, bytes or words. We see that our sophisticated marking systems loose their values, because we have to use – formerly unknown - statistically based A, B, C etc. marks and to find equivalent descriptors when co-operating with partner universities. We suffer that our national titles like Dipl. Ing., Dipl. Inz. etc. have to vanish from the national education market to give place for nameless and blood-arm Bachelors and Masters of xyz or anything within the field of science or engineering.

And, what is too much a bundle of work, we have to hand out the so called diploma supplement to the absolvent. This diploma-supplement has to describe the workload, the modules, the learning surrounding etc. and, by this, shall inform the later employer (and sometimes the student) what the absolvent - to become (hopefully) employed - has learned at the specific institution of higher education.

Why do we or, better, all the universities have to deliver the diploma-supplement? The answer is rather simple: Each university has to develop a unique study programme to come up with a specific or characteristic feature of its national and/or international – in this case EHEA – position of educating and training status or ranking. In Germany e.g. we like to use the wording of "being a lighthouse of education and science". So, each university wants to be a lighthouse in many different fields of education and science to make clear that it is really a lighthouse in these specific fields. But not everybody or every company will understand why to become and how difficult it is to be and remain a lighthouse.

This lighthouse or differentiation effect is so strong in specific engineering education fields - but not only in these fields - that e.g. a consortium of German civil engineering companies and associations started a campaign and made up a memorandum paper to come back to the "common civil engineering roots" and to educate and train civil engineering in the necessary time of at least seven (7) semesters and including the "right" professional topics in the respective "right" weights [3].

The demands concern not only the amount of semesters, but also the quality of education, the practice orientation, the demand of educating more qualified civil engineers, the necessity to gain back the German title of "Diplom Ingenieur", which was and should become again very famous worldwide. Asking for these qualifications they do not differenciate between University and Fachhochschule concerning the quality. But they state that more than 2/3 of all civil engineers are educated and trained by universities of applied sciences (Fachhochschulen).

Nowadays – astonishingly - the students in Germany started great protest actions against the school-like Bachelor and Master study programmes. In their mind – and not only theirs - these nearly completely fixed courses do not leave any freedom for personal scientific interests. Another point of criticism is the heavy assessment load at the end of each semester.

5. TARGET GROUPS AND HOW TO GET ACCESS TO THEM

5.1 Target groups

The objectives of the EUCEET WG G are aiming at two big groups:

- The universities abroad with their students and teachers on one side and
- the building industry with companies, associations and governmental bodies connected with building on the other side.

The working group G has the task to "Making the European civil engineering education better known and more attractive outside Europe". It was and still is mostly the task of the chairman to find out how to make clear and obvious, not only to students but also to responsible and competent members of universities, associations, societies, companies, administrative offices, engineering offices, consultants etc. how to attract students in civil engineering and adult civil engineers to "come, see and win" within European civil engineering education and training institutions – and possibly to find employment.

5.2 The classic way of actively distributing information

Three remaining and possibly successful ways have been used:

- direct or personal address;
- address via national and international civil engineering associations and
- "computerized" address directly or via universities or other partners.

All three paths mostly started after having personally informed beforehand the addressees via telephone call, personal visit and/or (which is the more realistic way) via e-mail and possibly Skype and other internet tools.

5.3 Being found via internet

The behaviour of these two groups to gaining information is different. Especially the attitudes of these two groups with respect to using the internet are even more different. The students in general are open or even like to use the net and to surf for something, what may be of interest. In general they also invest a lot of time to surf in or work with the internet to find selected information. But the possibility of a unique website to be found by these more singular processes is still rather small. As the other group members are much less active in surfing in the internet the finding process is of even less success.

6. ADDRESSING TARGET GROUPS ACTIVELY

6.1 Questionnaires for students and university coordinators

Before addressing the most important target group, namely universities and their students and teachers, it was necessary to find out how these groups are getting the information about study programmes.

So, the WG G decided to go the European ERASMUS-MUNDUS [4] programmes' way. This means that students and co-coordinators of all ERASMUS-MUNDUS programmes from 2005 to 2007 shall be and have been asked how they got or distributed their information about this common study programme. Of course, these programmes were not civil engineering connected programmes, which sometimes confused the co-ordinators, when they received the mail with the questionnaires.

Two questionnaires have been developed, one for the successful students and one for the co-coordinators of these study courses. These questionnaires were very simple. They are addressed to about 60 ERASMUS-MUNDUS universities and asked the following questions (this questionnaire is for the students; that for the co-ordinators is described in addendum II):

Questionnaire for incoming students

1. Where did you hear/got information about the programme?

- actual partnerships
- internet
- national exchange office
- international students fairs
- national embassy
- others

2. Why is this programme so attractive?

- high quality of teaching/learning in host university
- living standard in host country
- special study programme
- high grants
- language

3. What are the benefits of the study abroad when you are back home?

– better payment
– better working conditions
– better situation in society
– high quality education acceptance

The feedback was not too big according to the number of involved universities. But this is usual with such investigative actions. Nevertheless the number of answers was reasonable, and the answers gave a very clear view about the ways how students get the information about ERASMUS MUNDUS study programmes and what are the reasons to apply for these study programmes.

The total amount of answering universities is 10 (including a number of not mentioned partner universities), which represent 148 students from about 20 foreign countries who answered to the questionnaire as a group or personally.

Most universities gave "collected" answers; others sent a list of personal answers of the students. All together 15 "single" students in addition answered the questionnaire.

The list is as follows:

Czech Technical University of Prague, CZ	- 22 students	from 14 countries
Technical University Budapest, HU	- 21 students	from 15 countries
Technical University Delft, NL	- 9 students	from 4 countries
University of Leipzig, DE	- 3 students	from 3 countries
Technical University of Gent, BE	- 3 students	from 3 countries
University of Paris 1, FR	- 73 students	from 12 countries
University of Angers, FR	- 20 students	from 10 countries

Information Gathering and Advertisement

Concerning the way of getting the necessary information the order is as follows:

– internet	50 %
– actual partnerships	20 %
– others (friends, national societies, course flyer, …)	20 %
– national exchange office	5 %
– international student's fairs	- %
– national embassy	5 %

So, there is one very important way to find the right information of the ERASMUS MUNDUS universities, namely the WebPages of the respective universities via internet.

Two other ways are equally useful, namely the existing partnerships of the university where the students are studying and which has these cooperating universities, and a number of different other ways like friends, flyers, national societies etc.

All other ways are minor concerning the recruitment of ERASMUS-MUNDUS students.

- There was one very funny answer: "We are educating international vine makers and have nothing to do with civil engineering. So, our answers would of no help for you!?" As a non-professional vine farmer I could help the young lady co-ordinator, and afterwards I got a nice number of answers. -

Attractiveness of Programme

From all aspects there is no real first choice between:

– high quality of teaching/learning in host university;
– living standard in host country;
– special study programme;
– high grants and
– language.

Very often nearly all aspects have been of interest for each student.

Benefits of the study abroad when students are back home

From all aspects there is no real first choice between:

– better payment;
– better working conditions;
– better situation in society and
– high quality education acceptance.

Very often nearly all aspects have been of interest for each student.

The very few answers of the coordinators gave similar results.

Thoughts on the questionnaire

A strong driver obviously is life improvement. Should civil engineering departments be offering this? If we as civil engineers or educators do, will we be remembered and thanked for it?

Another strong driver is language and mobility. Both these are desirable, but are they central to EU civil engineering education? Perhaps they are secondary rather than primary benefits.

So far, live improvement seems more important to the students than technical benefits and technical and academic specialisation. But does this matter?

6.2 PR-work in national and international meetings

Word and paper

In all cases, as described below, the information has been given verbally and sometimes with the aid of a power point presentation. In all cases also a few (relatively old and not too attractive) leaflets have been distributed. But it was felt that it was a mess not to have actual advertisement papers of EUCEET III, actual in the sense, that they have to be targeted directly to the actual addressees.

It is difficult or nearly impossible to produce “hot” advertising written material. Leaflets and flyers give a quick overview about events, programmes, meetings etc. The attractiveness of such paper material very much depends on the author, of course. But what is attractiveness? Does it exist in general? It is very much dependent on the reader and his eyes and imaginations, or? If too much is written and if too few pictures are on the paper, nobody will have a look on it.

And, what is much more relevant: The number of directly addressed persons is rather small if one uses just words or printed material.

The following description of advertising activities shall not “honour the person”, but shall show the big effort to deliver information and advertising material to the target group association, companies and the building industries in general of the project. It is just a personal sample of activities in the year 2007 to make EUCEET and the work of WG G more famous.

ECCE 47th meeting in Athens, May 2007

This event is just an example of activities of EUCEET within this group. ECCE stands for “European Council of Civil Engineers” [5] and represents 22 European national civil engineering associations, including Russia and Turkey. ECCE is also member of EUCEET.

Other recent ECCE meetings took place:

– in Riga, LV, October 2007;
– in London, UK, May 2008;
– in Cyprus, Greek and Turkish part, October 2008;

– in Ljubljana, SI, May 2009 and
– in Helsinki, FI, October 2009.

The EUCEET III Program has been advertised during all these ECCE meetings by the ECCE Board rapporteur, who was me at that time, of the ECCE Standing Committee "Education and Training". It has been described in one of the parallel sessions and in addition to the whole General Assembly of ECCE. The long-lasting EUCEET activities are well known within the ECCE-group. The last third round has been supported by all 22 national ECCE member associations, as discussions within and after the session and meeting have shown.

The chairman of the Task Force Education and Training was and still is Professor Iacint Manoliu, professor of the Technical University of Civil Engineering Bucharest (TUCB) and – more important in this case - the Project Manager of the EUCEET-project.

WCCE 2nd Meeting of Executive Committee in Delhi, 11. Nov. 2007

This is also just an example how to distribute information about civil engineering education and training in Europe and the EUCEET-programme.

This 2nd Meeting of the "World Council of Civil Engineers (WCCE)" [6] Executive Committee took place in Delhi at 11. Nov. 2007. WCCE is also a member of EUCEET. And as vice-president of WCCE and chair of WG G I am bringing together both sides. The WCCE executive committee meeting took place in connection with the "World Federation of Engineering Organizations (WFEO)" Conference and the World Congress on Urban Infrastructure in Developing Countries organized by "The Institution of Engineers India (IEI)". This meeting was attended by

– the president of WFEO, Kamel Ayadi;
– the president elect of WFEO, Barry Grear;
– the vice-president of the IEI, B.J. Vasoya, and another member of IEI;
– the president of UK-Transparency International, Neill Stansbury, and
– a representative of the Brazilian Association of Civil engineers (ABENC).

So, concerning the presence and importance of these high ranked (civil) engineers, there is no other more important platform to talk about the excellency of European higher education and training for civil engineers. At the above mentioned event I gave a report about EUCEET III in general and its connection with WCCE, but the special part of this report concerned, of course, was the work of Working Group G "Making the European civil engineering education better known and more attractive outside Europe".

So, I could take the possibility to inform the attendees about the European Higher Education Area, the Bologna process, the ERASMUS MUNDUS Program and activities of EUCEET III and WG G. – I did it also to numerous participants of the whole congress, whom I met during the meetings and in between.

In connection with the meeting of the Executive Committee the Steering Committee of the "World Academy of Civil Engineers (WACE)" has been elected and had their first meeting. WACE should have be founded in connection with the 3rd World Engineering Convention 2008 (WEC) in the beginning of December in Brasilia, Brazil.

A co-operation with EUCEET III has been discussed; the knowledge and expertise, which has been accumulated through so many years within EUCEET, could help to find experts of high quality for giving lectures in WACE. WACE has not been founded yet. But WEC 2008 has given a very big platform to inform about EUCEET like in India one year before.

Other WCCE meetings in connection with big other international conferences took place also in

- Victoria Falls, ZW, June 2007
- Brasilia, Brasil, December 2008 and
- Kuwait City, Kuwait, November 2009.

Other meetings/possibilities

EUCEET information has been distributed by the author also during the annual meetings of the "American Society for Engineering Education (ASEE)", and there especially in the Civil Engineering Division, which consists of a rather great number of members.

All visiting colleagues from all our partner universities, independent whether they came from abroad or from Europe, got the information about the EUCEET programme – and the quality of European civil engineering education and training.

This was a little bit like "carrying owls to Athens", because we have come into contact and still enjoy this contact, because of our mutual understanding and acknowledgment of our education schemes and their quality.

Involvement of the WG G members and colleagues

All my colleagues who visited foreign partner universities have got the material to advertise European civil engineering education. In addition all members of Working Group G should and partly got in contact with their nationally involved universities, engineering societies and partners in the same way like described above.

7. WEBSITE

Website and electronic material

Within the information society the most effective advertisement happens and surely will happen electronically. As long as there is no e-mail list existing from members of a special target group e-mailing is not possible. So, one has to make up an open and public information platform in the electronic world. This, of course, means to make up an own website. The possibility that this platform will be seen and visited is not too big, even if the number of internet users worldwide is extraordinary huge.

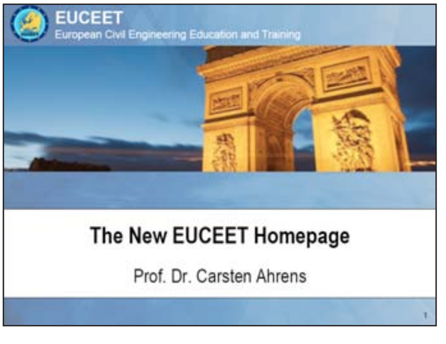
The work group G of EUCEET has done the step into the internet and has produced a renewed website. This website is hopefully attractive and informative enough to find a lot of visitors.

But how do visitors will find the "right" website? They mostly will use Google to search for a special product. On the other hand, this makes only sense and can work if they have an idea about what they are looking for. The keywords for searching may be "civil engineering", "Europe", "education", "quality" and so on. Everybody knows how many pages will be opened with these searching masks.

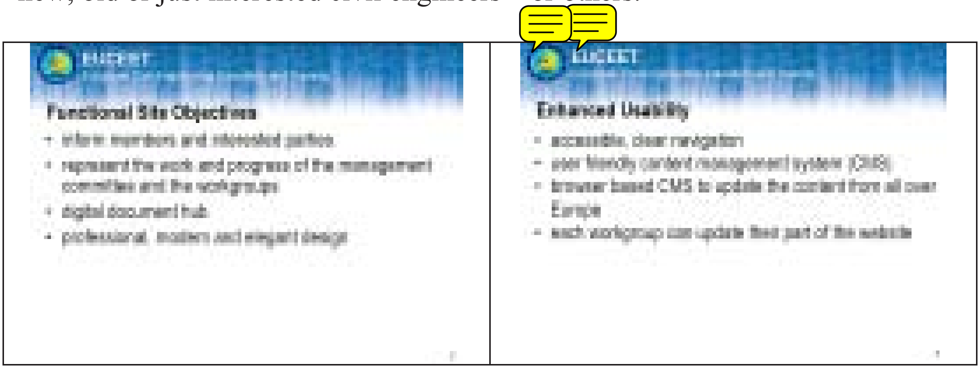
Another way to find visitors for the own WebPages is to being linked to/with other websites of in some way co-operating partners. Even the link from EUCEET members to the website has not been installed by all of them on the home website yet. Although EUCEET has around 100 members and associates, this number is still relatively small and, thus, this way is rather limited with respect to efficiency.

Concerning the questionnaires the result is that most information has been and still will be collected via internet. So, work group G made up a list of necessary data buttons and appearance demands of an own website as follows. The address of the website is www.euceet.eu and has been produced by the chairman of WG G together with professional help.

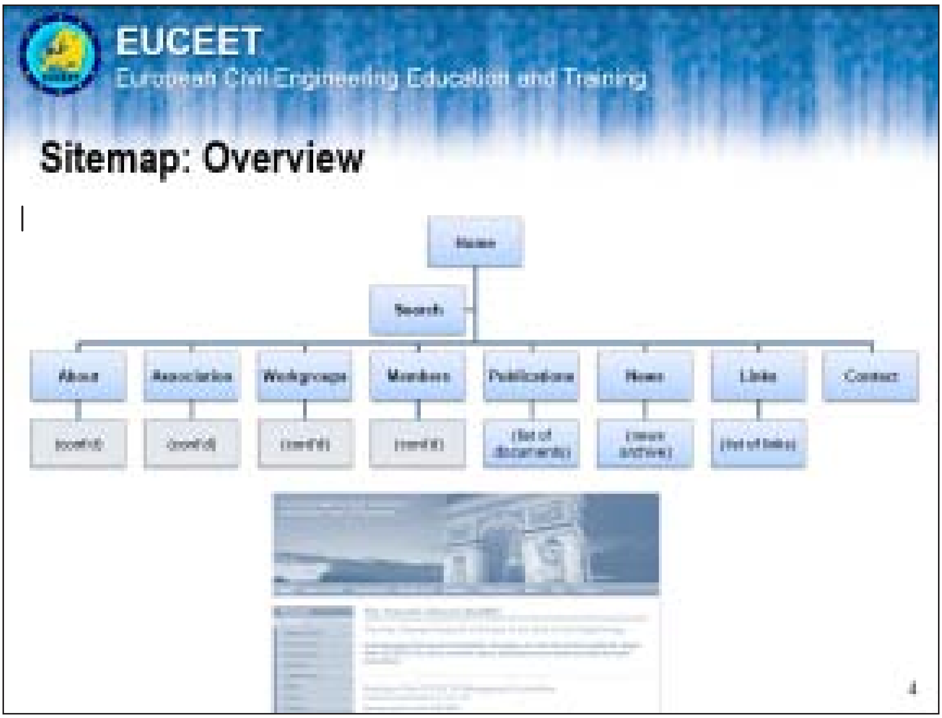
The EUCEET website/homepage



The idea and the contents of a new EUCEET- website have been presented at the Edinburgh management committee meeting in June 2009. All pictures of the different pages are from civil engineering works to attract especially such new, old or just interested civil engineers – or others.



Objectives of the new EUCEET homepage



Structure of the new website

Despite just presenting the new EUCEET website proposal the Edinburgh meeting was also dedicated to teaching, which in this case means, how to fill the respective sitemaps with useful and actual content. It was decided and, by this, given into the hands of each chair person of the working groups A till H to make up a vivid, actual and attractive sitemap for his or her working group.

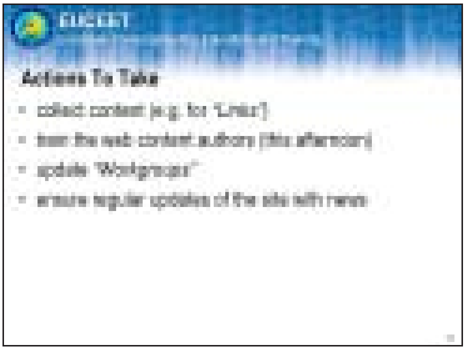
Sitemaps of “About EUCEET” and about the “EUCEET Association”

Sitemaps of “Workgroups” and “Members”.

The sitemap for members is interactive in the sense that a click on the map flashes the country and opens the contact data of all national members of this country.

Sitemaps for “Publications & News” and “Links & Contact”

These sitemaps are crucial for a successful website of any organisation. Without publication and really actual news the website seems to more a “dinosaur” instead of a vivid and active organisation. Links and contacts make the website more visible and/or a better target to become “googled” quicker and more often. So, all EUCEET members are asked and pushed to implement a link to EUCEET on their home university home-page. And hopefully this has happened till publishing this contribution to volume VIII.



Actions to take making the website successful and intention to activate users.

The “Entrance” to EUCEET via internet and its address www.euceet.eu.

EUCEET III will end at the end of 2009. It possibly will receive an additional year for disseminating its results, which are worth to be read not only but used within Europe in the field of civil engineering education and training.

The website of EUCEET may help to attract visitors, to make them interested in its contents and then to realize that EUCEET is really **“THE VOICE OF CIVIL ENGINEERS IN EUROPE”** as based on experience and training and as it is offered and practised by more than 100 high ranked EUCEET universities, associations and companies within Europe.

8. SUMMARY

EUCEET is the biggest European Thematic (SOCRATES-) network in the field of civil engineering, which is as EUCEET III embedded in the Lifelong Learning programme. The task of the Work Group G was and still is to “Making the European civil engineering education better known and more attractive outside Europe”. The problem of doing this job was and still is to find the right addressees and this in a number, which is big enough to distribute this information efficiently.

The classical way of distributing the information of WG G in national and international conferences and meetings via papers, lectures, flyers etc. was treated to be not very efficient. It is too much a person to person information and, thus, a single information exchange at times and incidents, where and when persons meet each other. In addition the informer cannot be sure that he really found an interested person and a multiplier of his idea.

The "new" electronic way via internet presence is much easier, because persons must not travel personally around the world to deliver the information of WG G. Just electrons can do the job. On the other hand it is very unsure whether there are interested persons, who are able to find the respective website and by this the information, which WG G likes to distribute.

It seems to be a general question how to find the right addressees worldwide in a worldwide web or within the information society and the global community system for the special purposes and demands, which an interested group wants to deliver to the interested public and its customers. May be there is a market for advertising specific information for specific customers.

9. ADDENDA

I. Work Group G members

N°	Institution	Name	G	Email
1	ENPC FR	Thibaut Skrzypek	X	thibaut.skrzypek@enpc.fr
7	AECEF CZ	Josef Machacek	X	machacek@fsv.cvut.cz
7	AECEF CZ	Jiri Vaska	X	jiri.vaska@nextradsl.cz
8	University Pardubice CZ	Vladimir Dolezel	X	vladimir.dolezel@upce.cz
9	Brno University Technology CZ	Petr Stepanek	X	stepanek.p@fce.vutbr.cz
11	Technical Univ Denmark DK	Jacob Steen Moller	X	jsm@byg.dtu.dk
14,17& 83	Fachhochschule Oldenburg DE	Carsten Ahrens	X	ahrens@bauing.fh-oldenburg.de
25	UPMadrid ES	Luis Garrote	X	garrote@caminos.upm.es
25	UPMadrid ES	Alberto Camarero Olive	X	tr09@caminos.upm.es
29	Univ. Castilla la Mancha ES	Rafael Blazquez	X	rafael.blazquez@uclm.es
36	ENTPE FR	Pascal Vincent	X	pascal.vincent@equipement.gouv.fr
45	Università di Trento IT	Riccardo Zandonini	X	riccardo.zandonini@ing.unitn.it
47	Università di Pisa IT	N. Squeglia	X	squeglia@ing.unipi.it
50	Technical University Riga LV	Juris Smirnovs	X	smirnovs@bf.rtu.lv
55	BUTE HU	Antal Lovas	X	alovas@mail.bme.hu
61	Graz University Technology AT	Stephan Semprich	X	stephan.semprich@tugraz.at

62	Wroclaw Univ of TechnologyPL	Piotr Berkowski	X	piotr@pwr.wroc.pl
74	LNEC PT	Pedro Seco e Pinto	X	pspinto@lnec.pt
74	LNEC PT	Joao Barradas	X	jbarradas@lnec.pt
87	Imperial College UK	Colin Kerr	X	c.j.kerr@imperial.ac.uk
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92	Norwegian UST Trondheim NO	Eivind Bratteland	X	einvind.bratteland@ntnu.no
95	Univ. Ovidius Constantia RO	Virgil Breaban	X	breaban@univ-ovidius.ro
	INSA Lyon	Fabrice Emeriault	X	fabrice.emeriault@insa-lyon.fr
	University of Patras	Stephanos Dritsos	X	dritsos@upatras.gr
	TU München	Ralf Reinecke	X	rr@ib-reinecke.de

II. Questionnaires

Questionnaire for students (see chapter 6.)

Questionnaire for co-ordinators of ERASMUS-MUNDUS universities

To all in the respective universities
ERASMUS MUNDUS Co-ordinators

Questionnaire:“*Making the European civil engineering education better known and more attractive outside Europe*”

Dear colleagues,

the Socrates Thematic Network European Civil Engineering Education and Training (EUCEET III) consists of about 80 universities, national associations and companies. EUCEET III has been established for the third period of its existence a number of themes, which concern the education and training of civil engineers European wide.

EUCEET III has eight Working Groups. The working group G that I chair is that one, which deals with the task **“How to make the European civil engineering education better known and more attractive outside Europe”**.

As a first step it could be of great help for our task if we can participate from your experience, which you have got and still receive from your students coming from your university partners around the world. It is of great interest for us to get to know why, how etc. your students got the information about your Erasmus Mundus programme, have chosen your university etc.

For this reason I have prepared a questionnaire for you as the co-ordinator and I kindly ask you to answer it, fill it out and send it back to me – together with those of the students.

On behalf of EUCEET and our Working Group G I thank you very much for your kind support and remain

Yours sincerely
Prof. Dr. Carsten Ahrens

EUCEET III Working Group G
Questionnaire for ERASMUS MUNDUS co-ordinators

1. Ways of advertising

- actual partnerships
- internet
- national exchange office
- international students fairs
- national ambassy
- others

2. Recruitment country city university number of students

……………….	……..	…….	…………..
……………….	……..	…….	…………..

Can you choose your students out of number of applicants?

3. General questions concerning stay of students in host university

Do the students receive grants- and if how much?
Can they study without grants?
How do you take care for the students?
Do you offer practical placement in companies?
Do students use this possibility to gain practical experience?

Is there a problem to send/bring back home the students after having finished their studies?

III. Target groups and website addresses/links

Associations in (Civil) Engineering

1 Names and Abbreviation

WFEO	World Federation of Engineering Organisations
WCCE	World Council of Civil Engineers
ECCE	European Council of Civil Engineers
ECEC	European Council of Engineers Chambers

1.1 (Inter)National Societies for Engineering Education

SEFI	European Society for Engineering Education
ASEE	American Society for Engineering Education
IACEE (see ASEE)	International Association for Continuing Engineering Education
iNEER	International Network for Engineering Education and Research
CESAER	Conference of European Schools for Advanced Engineering Education and Research
E4	Enhanced European Engineering Education
IGIP	International Society for Engineering Education
CLAIU	
EUCEET	European Civil Engineering Education and Training
JSEE	Japanese Society for Engineering Education

1.2 Accreditation Groups/Associations/Societies in (Civil) Engineering

	Washington Accord
EMF	Engineering Mobility Forum
	Sidney Accord
APEC	Asia Pacific Economic Community Engineer Register
FEANI	European Association of National Engineering Associations
ESOEPE and Education	European Standing Observatory for the Engineering Profession
ABET	Accreditation Board for Engineering and Technology, US

1.3 ECCE and national (Civil) Engineering Societies (nearly complete)

ECCE	European Council of Civil Engineers

ACECC	The Asian Civil Engineering Coordinating Council
ASCE	American Society of Civil Engineers, US
JSCE	Japan Society of Civil Engineers, JP
ICE	Institution of Civil Engineers, UK
CNI	Consiglio Nazionale degli Ingegneri, IT
CNISF	Conseil National des Ingenieurs et des Scientifiques de France, FR
VDI	Verein Deutscher Ingenieure, DE
BingK	Bundesingenieurkammer, DE
CICCP	Colegio de Ingenieros de Caminos, Canales y Puertos, ES
OE	Ordem dos Engenheiros, PT
IEI	The Institution of Engineers of Ireland, IE
RIOS	Russian Society of Civil Engineering, RU
PZITB	Polish Association of Civil Engineers and Technicians, PL
CKAIT	The Czech Chamber of Civil Engineers, CZ
RIL	Association of Finis Civil Engineers, FI
CACE	Cyprus Association of Civil Engineers, CY
IFD	Ingeniorforening i Denmark, DK
EACE	Estonian Association of Civil Engineers, EE
ACEG	The Association of Civil Engineers of Greece, GR
HCE	Hungarian Chamber of Engineers, HU
LACE	Lithuanian Association of Civil Engineers, LT
UAICR	Romanian Union of Civil Engineers Associations, RO
ZDGITS	The Slovenian Association of Civil Engineers, SI
TCCE	The Turkish Chamber of Civil Engineers, TR
CCAECE	Croatian Chamber of Architects and Civil Engineers, CR
LACE	The Latvian Association of Civil Engineers, LV
CACEM	Chamber of Architects and Civil Engineers of Malta, MT
SZSI	The Slovak Union of Civil Engineers, SL

2 Internet Addresses

WFEO	www.wfeo.org
WCCE	www.wcce.net
ECCE	www.ecceengineers.eu
ECEC	www.ecec.net

2.1 (Inter)National Societies for Engineering Education

SEFI	www.sefi.be	or	www.ntb.ch/sefi
ASEE	www.asee.org	cpd-link to	www.learnon.org
IACEE	www.iacee.asee.org		
iNEER	www.ineer.org		
CESAER	www.cesaer.org		

IGIP	www.igip.info
CLAIU	www.claiu.org
EUCEET	www.euceet.eu

2.2 Accreditation Groups/Associations/Societies

Washington Accord, Sidney Accord, Dublin Accord, Engineering Mobility Forum

	www.washingtonaccord.org
APEC	www.apec.org
FEANI	www.feani.org
ESOEPE	www.feani.org
ABET	www.abet.org

2.3 ECCE and national (Civil) Engineering Societies

ECCE	www.ecceengineers.eu (see above)		
ACECC	www.acecc.net		
ASCE	www.asce.org		
JSCE	www.jsce-int.org		
ICE	www.ice.org.uk	and cpd-link to	www.ttrecruit.co.uk
		and	www.tttrain.co.uk
CNI	www.cni.it	cpd-link to	www-ce.stanford.edu
CNISF	www.cnisf.org	and cpd-link	www.cefi.org
VDI	www.vdi.de		
BingK	www.bingk.de		
CICCP	www.ciccp.org		
OE	www.ordeng.pt		
IEI	www.iei.ie		
RIOS	www.rios.ru		
PZITB	www.zgpzitb.org.pl		
CKAIT	www.ckait.cz		
RIL	www.ril.fi		
CACE	www.cceaa.org.cy		
EACE	www.ehitusinsener.ee		
ACEG	www.spme.gr		
HCE	www.mmk.hu		
LACE	www.lsis.lt		
UAICR	www.utcb.ro		
ZDGITS	www.izs.si		
TCCE	www.imo.org.tr		
CCAECE	www.hkaig.hr		
LACE	www.lbs.building.lv		
CACEM	www.ktpmalta.com		

SZSI www.sksi.sk

IV. References

[1] www.euceet.eu

[2] www.bologna.org

[3] www.bingk.de

[4] www.eacea.ec.europa.eu

[5] www.ecceengineers.eu

[6] www.wcce.net

THEME H: Developing a synergy between academic and professional worlds

Report of the
Working Group

THEME H: DEVELOPING A SYNERGY BETWEEN THE ACADEMIC AND PROFESSIONAL WORLDS

Report of Working Group

Colin J. KERR[1]

1. INTRODUCTION

The proposal to extend the work of EUCEET into a third phase included a commitment to establish a Working Group to consider how to develop synergy between the academic and professional worlds. This would build on existing work undertaken by EUCEET, specifically Working Group C, which published a report dealing with synergies between universities, research institutes and public authorities working in the Construction Sector, and Working Group F, dealing with the demands of the economic and professional sectors and their impact on civil engineering education.

The work of the Group H began at the General Assembly, held in Santander during March 2007, where and an agenda, terms of reference and outline of working methods were debated and the scope of possible work was drawn up.

2. SCOPE OF WORK

Group H was therefore established to consider ways in which academic and professional partners within the EUCEET Consortium can work together, and with Industrial colleagues where relevant, to promote a better understanding of their complementary roles in the formation of Engineers and to consider how further collaboration can be encouraged and enhanced. Following the launch at Santander, a number of changes to the terms of reference and scope of work were suggested and by the end of 2008, a range of possibilities had been identified, which are listed below.

- To collect available information on what Industry looks for when appointing Engineers and to disseminate this information amongst EUCEET members so that it may influence the process of formation of engineers.
- To compile a dossier of this information to be made available to all EUCEET members to assist them when updating their curricula.
- To investigate and compare the different forms of industry/university partnerships in diploma studies, in-course industrial training and

[1] Chairman of the Working Group for the Theme H; Imperial College London, U.K.

professional experience which provide the practical formation of a Civil Engineer in each Member State. This may include the collection of information on ways in which academe and the professional domain currently interact and is likely to include specialist lectures, industrial advisory committees, assistance with design teaching, industrial placements, etc.

- On the basis of the above, to identify the best examples of innovative practice in these collaborations and to draw up guidelines, or best practice, on how such collaborations may be enhanced and extended.
- Recognising the potential importance of the free mobility of Engineers wishing to work in different countries within the EU, to develop a Common Platform for Civil Engineering. This may be defined as a set of criteria for professional qualifications which are suitable for compensating for the substantial differences which have been identified between the training requirements existing in the various Member States
- In order to assist in overcoming the problem of recognition, to offer a 'Quality Badge', perhaps along the lines of the Eurobachelor offered by the Chemistry Thematic network.
- To hold Workshops to which Industrial representatives would be invited to discuss the question of what Industry looks for in its young engineers. Such Workshop might also be a forum for posters illustrating innovative interactions with Industry and examples of good practice.

3. WORKING METHODS

Early on, we took the view that a considerable amount of information concerning Industrial links, needs of Industry, future educational directions and related matters already exists in the public domain, so our approach should be to review this and make its existence more widely known, rather that to carry out surveys de novo. However it was recognised that some survey activity would be necessary, for example, to update the nature of existing links and to compile details of new and innovative curriculum links with companies. However the general approach would be to complement and supplement existing work, not to repeat it.

It was therefore agreed that the main method of working would be via Working Group discussions supplemented by correspondence, e-mails and website postings, but it would be necessary from time to time to convene small ad hoc Groups for specialist discussions and for drafting documents. Membership of such Groups would be determined according to the task in hand.

4. REVISED TERMS OF REFERENCE

In the 18 months between the Group's launch in Santander in March 2007 and the General Assembly in Warsaw in October 2008, considerable revision to the aims and objectives of the Group took place, via discussions, e-mail exchanges and meetings. A certain amount of over-ambitiousness was recognised, particularly where there was considered to be a risk of EUCEET straying outside its sphere of real expertise. Another issue was one of resources; it became clear that members simply did not have the capability and the time to cover all the topics identified above, nor did it seem likely that Industrial colleagues would be willing to spend their time in completing more questionnaires and providing more details, at a time when their own resources are being stretched heavily. The third issue was one of repetition. Most countries had already undertaken a great deal of work to collect information germane to the issues being discussed here and it seemed much more sensible to make proper use of this existing material rather than embark on another information collection exercise. This certainly applied to the question of the Common Platform, but other issues, including the Quality Badge and Industrial Workshops, were considered to be too far outside the scope of the Group.

4.1 The Common Platform

The discussion on the Common Platform was let by members who also hold positions within Professional Bodies, including Carsten Ahrens (DE), Fernando Branco (P), Nicos Neocleous (CY), Tugrul Tankut (T), and were supplemented by further discussions with The Institution of Civil Engineers and Engineering Council (UK) and CNISF (FR). The Common Platform is intended as a procedure for facilitating the recognition of professional qualifications between EU Countries, to allow Engineers freedom of movement to work across EU borders. Essentially it can be defined as a set of criteria for professional qualifications which are suitable for compensating for the substantial differences which have been identified between the training requirements existing in the various Member States. It would be expected to include the validation of acquired experience, both academic and professional, coupled to a programme of continuing professional development.

The main point for Group H was that the Common Platform was seen primarily as a matter for the Profession, not the Academic community, and that EUCEET, an organisation comprised mainly of academic institutions, would find it difficult to take the lead in such a project. Furthermore, the different stakeholders have quite different roles in this matter. Universities start by equipping students with the fundamentals of the discipline and generic skills such as IT, communication and presentation, etc. Industry must find, employ and retain competent, useful and creative staff, training them in-house to fulfil company requirements. Regulators (Governments or Professional Bodies) need to be able to assess and compare qualifications and work experience. The main reasons for our difficulties are set out below.

- Discussions had been under way on this topic for many years and the most obvious routes to a Common Platform (eg the FEANI EurEng) had already been shown not to be suitable.
- The task was clearly a very difficult one, yet the number of professionals choosing to work in other countries and not being able to do so had been remarkably small, mainly freelance professionals. Would it be worth the effort to set up an inevitably complex bureaucracy which would probably only benefit a small number of people?
- At various times, policy had switched from the idea of a Common Platform for the whole of Engineering to one of a CP for disciplines within Engineering.
- Even amongst like-minded people working in the Profession, it was difficult, if not impossible, to come up with a definition of Civil Engineering acceptable to all Member States.
- There was a conflict between the drive to regulate and control Professions and the predominant ‘free trade’ ethic, which would not easily be resolved and which EUCEET was not well placed to influence.

Despite this, the need to protect the title of Civil Engineering was recognised, as was the principle of allowing appropriately qualified people to practice their profession in any country. This being so, members saw an important role for Group H in assisting ECCE, the European Council of Civil Engineers, in its deliberations on the Common Platform, but not in taking a lead in this matter.

4.2 The Quality Badge

Although the promotion and maintenance of quality is a key objective of any University at a local level, it is normal for an overview to be taken by a national agency, albeit one which uses the expertise of academics and former academics, often as specialists or consultants. While recognising the potential importance of this matter, we consider it inappropriate for EUCEET to play a major role. This is something best left to national agencies or perhaps to a pan-European grouping of national quality agencies. The role of EUCEET, the EUCEET Association or individual members should be to act as technical and educational specialists.

4.3 Industrial Workshops

The possibility of EUCEET organising Industrial Workshops to develop synergies was actively considered. Most members have good networks of industrial contacts and a good understanding of sector needs within their region or country and many already organise meetings and discussions. In addition, there is a considerable literature of Government and Professional reports dealing with the needs of Industry and how the academic sector might be able to meet these. EUCEET certainly has a role to play in gathering and disseminating information about Industrial needs, by collecting this informationr, summarising and disseminating it as part of a national 'State of the Art Report' for individual countries. However, detailed work is probably best done at local level, based on existing networks and contacts.

5. FINAL TERMS OF REFERENCE

With all this in mind, the terms of reference of the Group were finally limited to three main areas:

- A brief survey of the nature of current links between Companies and Universities
- Collection of information on innovations and good practice: innovative ways of working with Industry
- National 'State of the Art' Reports

5.1 A Survey of Current Links

This was intended as very brief survey which would allow us to update our information on the type of links which exist between Companies and Universities, including information on how important these links are considered to be. All EUCEET members were invited to complete a questionnaire and results are given in section 6.

5.2 Innovative Ways of Working with Industry

The idea here was to gather together examples of innovative links with Industry and the Profession which we can publicise amongst our colleagues as examples of good practice. All EUCEET members were provided with details of some 'good and innovative' example of how Universities are linking up with Industry to enhance both the curriculum and the student experience, and were asked to provide similar or better examples from their own Institution. This information would then be compiled and used as a handbook of good ideas. Details are given in section 7.

5.3 National 'State of the Art' Reports

Here, nominated authors were invited to prepare a summary, based on existing documents such as Government and Professional Body reports, articles in the technical and professional press, etc, summarising current views and opinions of industrial/academic issues, focussing on the topics listed below:

- Manpower supply for Industry
- Quality & competency of current graduate output
- Difficulty or otherwise of finding and returning suitably qualified personnel
- Future training needs
- Perceived/ required changes in engineering education
- Impact of the current economic crisis

A template document, representing the situation in the UK, was circulated as a guide to what was needed, and the nominated authors submitted material relevant to their countries. A summary of the key issues raised in these reports is set out in section 8 and the reports themselves are given in Appendix 2 of this report.

6. THE NATURE OF CURRENT INTERACTIONS WITH INDUSTRY

The Group carried out a short survey in order to provide an update on the type of links which exist between Companies and Universities, including information on how important these links are. Most university Departments already have significant links with Industry and the Professions and many of these are well established and fairly standard. Earlier work (eg EUCEET Working Groups C and F) has covered this topic, and this survey is intended simply as an update. Contributors were asked to indicate the type of interactions they have and how important they are to the University, by completing the table below, on a scale of 1-5, 1 being very important, 5 being of no importance. Five typical examples are given, many contributors added others.

ITEM	1	2	3	4	5	N/A
Use of Industrialists to give special lectures						
Site visits for students						
Placements in Industry						
Careers advice provided by Companies						

ITEM	1	2	3	4	5	N/A
Use of Industrialists in specialist practical areas, eg design classes						
Use of Industrialists in specialist teaching areas eg construction management						

Twenty-two submissions were received and the results are given below.

6.1 Use of Industrialists to give special lectures

All but one of the replies indicated the use of Industrialists to give special lectures and 67% said that this was an important or very important example of collaboration. 18% were neutral on this and 9% thought this was not very important.

6.2 Site visits for students

All respondents organise site visits. 72% consider that the use of site visits for students is important or very important, while 22% think that this is not very important or not important at all.

6.3 Placements in Industry

Again, all respondents have industrial placements of one sort or another. 64% think that this provision is important/very important for their students, while only 14% consider that this is not at all important.

6.4 Careers advice provided by Companies

All but one respondent makes use of careers advice for students provided by Companies and of these, 50% say that this is either important or very important. 18% are neutral and the rest (23%) say that is not important.

6.5 Use of Industrialists in specialist areas, eg design classes

9% of respondents do not use Industrialists as specialists in their design classes, but of the majority which does, 54% considers this to be important/very important, and only 13% say that it is not important.

6.6 Use of Industrialists in specialist areas eg construction management

18% of respondents do not use industrial experts in the teaching of construction management, but it is not clear if this is because they do not teach this subject, or that they do, but teach it themselves. Of those using industrial specialists, 50% consider this link to be important/very important and 13% say that it is not important.

6.7 Other types of links

Respondents listed 20 other ways in which their teaching is supplemented by links with Industry, but because these were not on the original list, it is not possible to say how widely used they are. Some of them are very similar, so they have been summarised and listed here, as suggestions and recommendations of how Universities might be able to extend their links to Companies, if they are not doing these things already.

- Use of Companies to give whole specialist courses
- Presentation of the activities of Companies and Professional bodies
- Involvement of Companies in final year projects, thesis and dissertation work, both as technical collaborators and as examiners. This can lead to a good appreciation of applied research and problem solving for Companies
- Use of Industrialists to serve on University Committees, Boards and Special Strategy Groups
- Provision of scholarships to students
- Sponsorship of Student Associations and Student Unions
- Construction fairs and exhibitions organised by students
- Professional Days and conferences organised by Companies
- Induction programmes for new students, involving Professional Bodies, Companies and Unions. This introduces the Construction Sector in a very practical way
- Summer vacation work, internships and assistance with first employment after graduation
- Collaboration with Companies over research and other innovative initiatives
- Establishment of professional standards, assistance with curriculum design and in setting out what student have to study
- Cooperation in lifelong learning programmes
- Industrial collaboration in design projects. This is an extension of the involvement in design classes indicated above

It is evident that many types of links exist already and that most Universities take the trouble to cultivate them and consider them to be important. The types of link which operate are not particularly unexpected, but some of the 'one off' suggestions listed above are worthy of wider consideration. For example, anything which enhances the exposure of student to real engineering life is likely to be beneficial all round, and anything which Companies can do to enhance the students' learning experience is likely to make a positive impression when it comes to employment of good graduates. This applies to the social side of University life (sponsoring student clubs and activities) as well as the educational side.

It also seems clear that external contributors can make a complementary contribution, bringing professional aspects which are much more the province of the Industrialist than the Academic. While the University rightly focuses on the fundamentals, the industrial contribution is better focussed on professional aspects including, for example, construction logistics, project management, civil engineering as a business and, perhaps most important of all, getting over the importance of professionalism in working life. The overall aim should be to strike a balance between scientific rigour and the inspiration which exposure to real case studies can do to motivate students.

7. INNOVATIVE WAYS OF WORKING WITH INDUSTRY

There has been much discussion in recent years about the need to revise and update curricula, and to make them more relevant to the needs of Industry. This section of the report describes a number of new initiatives designed to develop, extend and improve collaborations, bringing new approaches to study programmes. Some are refinements and developments of well-established forms of collaboration, while others are new and more innovative. Twenty five organisations contributed examples which fall into a number of categories, including:

- Opportunities to meet Companies and find out what they are doing
- Finding out about career opportunities
- Being inspired by exposure to real engineering problems
- Seeing 'design' is a wide context, involving technical, social, economic and environmental aspects
- Bringing industrialists into the teaching process, for professional expertise and for inspiration
- Promoting competitions, challenges and problem solving
- Supporting student life and social activities

The material submitted by Institutions is set out below as examples of good practice. Where possible, contact details are given so that those who are interested can seek further information. The organisations submitting material are listed below, alphabetically according to the way in which they are best known (shown in **bold**), followed by the material itself.

Budapest University of Technology and Economics, Hungary
Cardiff University, UK
Conseil Nationale des Ingenieurs et Scientifiques de France (**CNISF**), France

Technische Universitat, **Darmstadt**, Germany
TU **Delft**, Holland
TU **Denmark**
Ecole des Ponts Paris Tech (**ENPC**), France
Ecole Superieure des Travaux Publics, du Bariment et l'Industrie (**ESTP**), Paris, France
Helsinki University of Technology, Finland
Imperial College London, UK
Institut National des Sciences Appliquee, (**INSA**), Lyon, France
Laboratoire Centrale des Ponts et Chausees (**LCPC**), France
Institut Superieur du Batiment et Travaux Publics, (ISBA-TP) **Marseille**, France
Middle East Technical University (**METU**), Ankara, Turkey
Fachhochschule **Oldenburg** (now the JADE Hochschule), Germany
University of **Pardubice**, Czech Republic
University of **Patras**, Greece
University of **Pisa**, Italy
Universidade do **Porto**, Portugal
Czech Technical University, **Prague**
TU **Riga**, Latvia
Escuela de Caminos de **Santander**, Spain
Technological Education Institution, **Serres,** Greece
TU **Tallinn,** Estonia
Timisoara, Romania

7.1 Budapest University of Technology and Economics (BUTE)

Contact: Antal Lovas alovas@mail.bme.hu

7.1.1 Civil Engineering Week

The Civil Engineering Week has been a major and part of the life of the Faculty since October 2000. It takes place in the autumn semester organized by the students. The aim is to make connections between the students and professors with the companies who are from the civil engineering profession in Hungary. They can offer complex opportunities to our exhibitor Companies to show a wider picture about their work, products and the technologies they are using. With a large set of presentation accessories, the delegates of the Companies can represent their work and products and can also give information about their expectations for their future colleagues. A professional excursion is also involved, the main aim of which is to visit many different construction sites located around Hungary. The biggest success every year is the Bridge Modelling Contest.

7.1.2 BME Civil Engineering College for Advanced Studies

The BME Civil Engineering College for Advanced Studies functions as an efficient organization at the Faculty of Civil Engineering at the Budapest University of Technology and Economics, founded in 2004 by 10 self-motivated and committed students. The College consists of 80 members at present and is divided into 5 sections: Section of Structural Engineering, Section of Hydraulic Engineering, Section of Engineering Informatics, Section of Transportation Engineering and Section of Surveying. The main activities are organizing professional excursions, lectures and any other professional events.

7.1.3 IAESTE – Hungarian Group

BUTE has an active IAESTE Group, which brings together students wiling to work with companies with industrial problems to tackle. The main aim is to expose students to a professional working environment and to real industrial problems, by a mixture of brainstorming, exhibitions, surveys, posters, and social events.

Further information:
http://bme.iaeste.hu
http://sz7.iaeste.hu

7.2 Cardiff University

Contact: Alan Kwan kwan@Cardif.ac.uk

At Cardiff, a number of opportunities, some new, some not so new, are offered to students to enhance their interaction with and knowledge of the Industrial scene. One aspect is to involve industrialists directly in teaching programmes, where they give lectures, advise on curriculum content and become involved in design projects, particularly in interdisciplinary aspects.

7.2.1 Careers Fairs

Careers fairs are held in the School, over 2-3 days, when some 40-60 firms come in with their stands and “mingle” with our students. There are also 20-30 evening presentations from companies per year. The main purpose is to showcase their work and examples of exciting projects with which companies are involved, though the Companies also use them as a recruitment exercise.

7.2.2 Development of Practical Skills

Companies are also involved in giving “skills sessions”, showing students real examples of industrial practice. This is good for the students, but also an opportunity for companies to increase their profile amongst the students. Companies also take about 20 students on sandwich placements. This gives students good exposure to real industrial work and excellent opportunities to develop contacts. In addition to these year-long placements, Companies also take students for site visits, though these can be difficult to organise for large groups, and also for summer placements.

7.3 Conseil Nationale des Ingenieurs et Scientifiques de France (CNISF)

Contact: Francois Gerard Baron FGBARON@clubinternet.fr

The contribution from CNISF covers the sector as a whole, and this section outlines activities taking place in a number of French Institutions.

7.3.1 Joint Training in Schools and Companies

Fifteen « Grandes écoles d'ingénieurs », including ENSAIS Strasbourg, Polytechnique Lille, CNAM, SCITC , ESTP, etc have a scheme in which 15 % of their students are educated through a programme divided between Schools and Companies. After completing their BTS (Brevet de Technicien Supérieur) or DUT (Diplôme Universitaire de Technologies they are recruited to Grandes Ecoles, but spend half their time in academic education and half in professional education in civil engineering Companies.

Within the Companies, students must attend mandatory training periods in the first and second years, involving work practice, choice of materials and site practice and responsibility. They must also complete a period of training period abroad, very often in Design offices or Companies.

7.3.2 Les Grands Ateliers de l'Isle d'Abeau (www.lesgrandsateliers.fr)

This programme, which has similarities to Imperial College's 'Constructionarium' (see below) was initiated by Grandes Ecoles dealing with Architecture, Art and Engineering. Its goal is to develop new studies and educational practices based on approaches with materials, structures, and living space. A number of institutions, including INSA (Institut National des Sciences Appliquées) and ENTPE (Ecole Nationale des Travaux Publics de l'Etat), both located in Lyon, are very active in this. The programme comprises academic studies and practical construction of a structure (or structural element) carried out in huge halls installed in L'Isle d'Abeau (Isère) where models are built, dealing with innovative structural elements built in stone, concrete, wood, textile, and so on. Groups of students undertake the design and the construction, but construction materials and handling support are offered by Civil engineering firms.

7.3.3 Creative design

A number of Grandes Ecoles have developed new courses and collaborations which deal with the industrial dimension. Some of these include:

- Common courses between Ecole Nationale des Ponts et Chaussées and Ecole d'Architecture de Marne-la-Vallée
- Development of new courses in eco-design and climatic engineering, ENSAIS (Strasbourg)
- Employment Shows. Grandes Ecoles organize shows, where Civil Engineering firms Design Offices book exhibition space for 2 or 3 days to display their activities and present employment opportunties to students
- Competitions. Some Companies (Bouygues for example) organise a competition between pairs of students, one in civil engineering, one in business, dealing with the the design and economics of a structure or building.

7.4 Technische Universitat Darmstadt

Contact: Ulvi Arslan arslan@iwmb.tu-darmstadt.de

7.4.1 Planning, Design and Constructing

At Darmstadt there is a particular Working Group "Planning, Designing and Constructing", which is responsible for the organization and performance of the orientation of courses within the basic study period in civil engineering and surveying. The courses' ultimate ambition is the students' orientation for the organization of their studies and subsequent field of activity. Through the participation in two different projects planning games the students get the impression of the characteristics of an engineer's project work process regarding the typical organizational structures and workflows. The intent is not only to deliver an insight into the fields of activity of a Civil Engineer or Surveyor, but also to contribute to the students' job qualification and self development. The project planning games simulate typical workflows and demand a thinking in alternatives as well as a readiness to deal with tasks, which are not explained in detail. Therefore the students have to show a high degree of their own initiative as well as the ability to cooperate and to make compromises. In the same time the students' personal skills, like their ability of expressing themselves or of presenting results, are trained. The courses are held as seminars. The students take part in groups of up to 15 participants. The groups are advised by collegiate tutors or research associates. Besides this specialty there are also similar opportunities likely at other universities. Lectures by industrialists,

7.4.2 Career Fairs and Joint Training in Companies

These are offered to students to enhance their knowledge of engineering practice. Career Fairs are held at the university over 2-3 days every year in autumn, where many companies and all departments of the university present their work and examples of exciting projects. Further information:

http://www.konaktiva.tu-darmstadt.de/
http://www.elc.tu-darmstadt.de/

7.5 TU Delft

Contact: Ellen Touw E.Touw@CiTg.TUDelft.NL

7.5.1 BlueDot

BlueDot provides the link between the conceptual work of students and the professional market of consumer products. The foundation functions as a platform and as a label, helping talented students of the DUT by bringing their products to the market. By bringing together the knowledge and experience of both the DUT and the business sector students can commercialize their product and gain valuable experience. The products are produced under licence and sold as Blue Limited University Editions under the label BlueDot. By promoting both the students and their products a more direct link between consumers, companies and students is created. http://www.blue.tudelft.nl/

7.5.2 De Delftse Bedrijvendagen

Over the past thirteen years, 'De Delftse Bedrijvendagen' has been the best way for students from Delft to establish contact with companies that are of interest to them for possible internships, graduation research projects and job applications. Every year, approximately 1300 students participate; therefore two thirds of all graduating students visit the career fair. This is a unique opportunity to establish contact with Master of Science students of the internationally acclaimed Delft University of Technology. In 2008 102 companies participated in the Presentation Days and all participating students visited this main event of 'De Delftse Bedrijvendagen'. Because of the success of the Application Training it has been extended to two days in 2008 which allowed 500 students to participate. Most of the In-house Days, formerly known as Workshops, were held at the company's location, while some took place in Delft. The In-house Days were spread over three weeks so that more students could visit these In-house Days. In total 450 students took part in the In-house Days. Last year, 60 companies participated in the Interview Days, in which more than 650 interviews with 325 different students took place. http://www.ddb.tudelft.nl

7.5.3 Techno-starters

The TU Delft wants high-quality research to be translated into hi-tech activity around the university campus. A structural approach is needed to identify and develop this concept, and this is emerging in the shape of a partnership with the market parties: government organisations, businesses and investors. Activities include spin-outs, spin-offs and joint ventures. The TU Delft is particularly keen to offer opportunities to techno-starters demonstrating the potential to build up a structural relationship with the university. Technosprint was set up to search for potential starters fitting this bill, with the aim of allying them with the university via an incubator function provided by YES! Delft.

The aim of Technosprint is to identify (new) knowledge within the TU Delft, to estimate its commercial value and to pass it on to the business sector. The emphasis is on the transfer of knowledge to (pre-) techno-starters. If this knowledge is to be put to optimum commercial use, a dynamic and sustainable interaction will have to be generated between institutes of knowledge, intermediary organisations and the business sector. All parties will have to make an active contribution in identifying, patenting and transferring commercially useful.

The knowledge acquired in this way will then be conveyed to those market parties in a position to put it to good use. The aim is that all partners in the consortium will act together to bring about more alignment between demand and supply on the knowledge market. Technosprint aims to double the number of (pre-) techno-starters in the Delft region from 15 to 35 per year and to increase the number of inventions/patents from an average of 18 inventions per year to approximately 25. In concrete terms this means that more than 100 new entrepreneurs (techno-starters), 25 new patents and some 30 patent transfers will have been realised by the year 2010.

YES! Delft, the Young Entrepreneurs Society Delft, , has been set up especially for techno-starters: high-tech entrepreneurs wanting to start their own business. YES! Delft helps techno-starters to overcome or minimise the obstacles facing start-up businesses. Alongside this, YES!Delft also tries to make students aware of the challenges and possibilities involved in starting up your own business.

7.5.4 Internships/ Traineeships

All MSc- curricula offer practical work experience in day-to-day practice of civil engineering companies or institutes (contractors, consultancies, government, non-governmental organisations, etc.) in the Netherlands or abroad. The main objectives are:

- To develop your general engineering skills
- To learn how to apply your technological know-how

- To put into practice any social and communication skills you might have
- To gain a more complete insight into your own particular aptitudes

7.6 TU Denmark

Contact: Jacob Steen Moller jsm@byg.dtu.dk

7.6.1 Student projects with Industry

Students, especially on the MSc programme, are included in research and consultancy work for industry. Typically a company will contact DTU Civil Engineering with a practical problem. The company and teacher of the university defines a thesis or project topic and the students carry out the assignment as part of their study.

7.6.2 Projects in Greenland

Every year DTU sends approx. 40 students to Greenland. The students have identified a number of practical problems suggested by Greenlandic companies or authorities beforehand. During a 3 week summer school in Sisimiut, Greenland they carry out investigations, experiments, monitoring and testing on site in the Arctic environment. The results of the student projects are handed over to the local users and typically a public presentation is given.

7.6.3 Industry Panel

Every 18 month a workshop with is conducted with the purpose of bringing industry, researchers and teachers together to discuss the curriculum and relations with industry. Around 50 industry representatives participated in the last workshop on the topic of University/Industry collaboration. The Department also has a permanent Advisory Board consisting of 5 high ranked industry managers.

7.7. Ecole des Ponts, ParisTech (formerly ENPC)

Contact: Thibaut Szrypek thibaut.skrzypek@enpc.fr

7.7.1 Opening seminars

It is sometime difficult for students to understand finely the stakes and context of the industrial world. In order to make them more receptive to these matters, we have to extract us from the classical rhythm of lessons by organizing one week seminars at the beginning of the year. During those seminars, focused on definite themes, Engineers coming from industrial companies are invited to present specific technologies and to initiate students to their activities. One example is a week-long programme on innovation in concrete, dealing with special concretes such as fibre-reinforced concretes, self setting concretes and laboratory visits, conference-style presentations and quizzes. A second, also a week long, on geotechnical engineering, covers the use of novel techniques, applications, workshops and conference-style sessions

7.7.2 Projects with industrial partners

ENPC organizes projects with industrial partners for small teams of students, based on real case studies. The industrial partner and teaching staff define the scope of the work to be undertaken by the students, who apply skills and knowledge learned from many parts of their theoretical studies, use professional software, tools and equipments and gain experience of project management at a real scale

An example of this is based on the design of a bridge and simulates the client-consultant-contractor situation, focussing on creativity, conceptual design, calculations and construction. The programme is structured as follows:

- Two sessions for preparation, collection of information, including site visits
- Five sessions on conceptual design and calculations
- Five sessions on detailed construction methods and procedures
- A final session presenting the results

In the final presentation, the students outline the range of options, justify the one they have chosen, set out their calculations and describe the construction methods they use. They must also submit drawings.

7.8 Ecole Superieure des Travaux Publics, du Batiment et l'Industrie (ESTP Paris)

Contact: Marie-Jo Godaert goedert@adm.estp.fr

7.8.1 The ESTP Construction Fair

This is a student-let activity. Each year, the Students' Union organizes a "Construction Fair, in which they rent an exhibition hall and sell exhibition spaces to companies. In 2008, 120 exhibitors participated at "Paris Porte de Versailles Exhibition Hall", to present their company and its activities and to recruit students for internships and first jobs. Entrance is free, attendance around 4.000 visitors, mostly civil engineering students from all over France. A cycle of conferences complete the exhibition space. Each year a VIP such as a government minister inaugurates the Fair. Apart from the obvious benefit for the visiting students, this event represents an excellent training in management for the organising team.

7.8.2 Professional days as part of the curriculum

During the academic year, 6 lecture free days are scheduled in order to allow students to meet and interact with companies. Each day is dedicated to particular themes, for example, environmental engineering, real estate management, health & safety, quality management, transportation, energy and so on. The days incorporate events such as conferences, presentations, site visits, mock job interviews, and give students excellent opportunities to make contacts.

7.9 Helsinki University of Technology

Contact: Juha Paavola juha.paavola@tkk.fi

7.9.1 Getting to Know the Industry

The relationship between students and the Industry at HUT has traditionally been cultivated very actively and both parties welcome this versatile co-operation. Co-operation starts at the beginning of academic year and continues throughout the studies. Students get some preliminary knowledge of the demands expected of them, form contacts to the professional world and get some impression of real working life. The industrial side will learn about students as potential employees and get also some information about the university practices and syllabus. Very often this fruitful co-operation will be deepening during the student days already, by various traineeships in the summer and Christmas holidays. The common symbiosis often culminates in the MSc- or Diploma-thesis which often involves industrial sponsorship and tuition.

The collaborative companies welcome the freshmen during their first weeks in many events, for example during the distribution of students' overalls and sports day.

7.9.2 Uniforms

Overalls are one of the characteristics of engineering students along with the technology student cap. Similar appearance brings students of the same study program closer together, as different study programs have differently colored overalls. On the second day of autumn semester every year, the freshmen get their overalls. One of the major Construction Companies donates the overalls and the representatives come to help with the distribution and a manager give a speech about the importance of studies. At the end, students toast for their studies and co-operation with the Company.

7.9.3 Social Interactions

The Guild of Civil Engineers has traditionally promoted interaction between students and industry. It is an active subgroup of The Student Union of HUT. The Guild, founded in 1913 has a long and distinguished history and a membership consists mainly of students of Structural Engineering and Building Technology and Transportation and Environmental Engineering. It plans and organizes parties, excursions, theatre visits, sport events and other events for its members, with many of these activities designed especially for the freshmen. The guild also manages publicity, having an influence on study matters and informing about them. These activities are made possible with the help of Finnish Construction Companies, Industry and Associations.

Sports day is organized for the freshmen a few weeks after beginning of studies. It is financed by another major Construction Company. During the sports day, a group of freshmen go to a forest to play paintball with the representatives of the company. The evening continues with dinner, during dining the students get to hear more about the Company. As always in the Guild events, there is also a possibility to go to sauna and discuss topics of mutual interest in a more relaxed manner.

7.9.4 Real Life Bridge Design and Competition

Another approach used at HUT is to use the Masters Thesis as a vehicle for analysis of a real problem of current interest and importance. One recent good example considers the load carrying capacity and service life of Brandostrooms bro suspension bridge. A detailed exercise is set out involving general design of a simple two-lane reinforced concrete girder bridge with abutments founded on rock or soil.

In spring 2007, a design competition between the Bridge Engineering students at TKK was arranged for constructing a real bridge over a small pond on the backyard of the Civil Engineering building. The five-member jury consisted of the Professor, a bridge design engineer from a consulting engineering company, another bridge engineer representing a contractor firm and two student representatives, one from Civil and one from the Architectural Department. Altogether 12 proposals were left in. To the designers of the three best proposals were awarded a prize: 2000, 1000 and 500 Euro, respectively. The money was provided by the industry. The quality of the proposals was surprisingly high considering that the participants were the third and fourth year students. All three winning proposals were prepared by the fourth year students, which indicates that one year more studies clearly gives advantage in such design competitions.

In another example, A 50 years old suspension bridge was load-tested and analysed to assess its load-bearing capacity and remaining service life. The project was carried out by a final year student as a Diploma Work (Final

Project) study completed in April 2008. The instructor of the study came from a private enterprise responsible for the investigation. It was an excellent opportunity for the student to become acquainted with real problematic of a relatively big suspension bridge (main span 98 meters). The abstract of the study is enclosed (Enclosure 3).

7.10 Imperial College London

Contact: Colin J Kerr c.j.kerr@imperial.ac.uk

7.10.1 The Constructionarium

It has been recognised for some time at Imperial that undergraduate students, although academically very able, have little experience of or skill in working with hand tools and therefore little understanding of how to go about the task of building a physical artefact. To address this perceived deficiency, a one-week field course - The Constructionarium – is held at the end of the second year. With support from construction companies, teams of students are required to construct, safely, efficiently and economically, a reduced-scale version of an existing design. Further details are given in the 2 attached files and web link below:
http://www3.imperial.ac.uk/pls/portallive/docs/1/16645697.PDF

7.10.2 Industrial Contributions to Creative Design

Imperial has recently appointed as Adjunct Professor of Creative Design the Director of Structural Engineering of an International firm of consulting engineers. Design is an essential thread that must run through all stages of an undergraduate course and the best way of ensuring that students are excited and inspired by exposure to real engineering design is considered to be through the involvement of leading professional practitioners working together with academic staff. The new Professor has developed a course base on practical project work which gives a clear impression of all the issues that influence design decisions at the conceptual stage. The course is tutored as studio work by 6 young engineers from the Professor’s company, together with a matching number of academic staff. Funding for the course is provided jointly by a charitable trust associated with the company and my Imperial College. Further details are given at:
http://www3.imperial.ac.uk/newsandeventspggrp/imperialcollege/newssummary/news_31-3-2008-14-56-27?newsid=32134

7.10.3 Meet the Industry

Every year we organise an evening event with about 20 of the leading civil engineering companies coming to the College to meet our students. They bring the sort of display stands and literature which you would expect to find at a conference or exhibition. The event is partly social and partly a networking opportunity and it gives the students the chance to talk to companies about the type of work they do. It is not a recruitment event as such, but students do take the opportunity to get to know about companies, which is a great help to them when they come to the time to look for jobs.

7.11 Institut National des Sciences Appliquee (INSA) Lyon

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7.11.1 Promotion of a Class by a Company

In 2008-2009, each of the class of the Civil Engineering Department will be promoted by a French company or organization (GFC construction, SCET and Maia Sonnier)

The program includes:

- Internships that are offered to the students (approximately 10 % of the class, i.e 10 students)
- Simulation of job interviews (performed by the company Human Resources representatives),
- Site visits (at least 2 during the academic year, duration 1 day each, for the whole class)
- Participation in the cycle of “Conférences metiers”.

7.11.2 Cycle of “Conférences métiers”:

Managed by the Civil Eng. Dept. student association, a series of 7 to 8 conferences are organized throughout the academic year (one every 3 weeks). Representatives of several companies (generally 3 per conference) and “young” alumni participate in these 2 to 3 hours conferences aimed at presenting one specific aspect of the Civil Engineering. Therefore, these conferences illustrate the wide panel of possible future missions and jobs for the students.

7.11.3 Final Year Integrated Project

During the final year of studies, students can choose, in addition to their final year research project, a so called ‘Technical Project’ in three different majors; Urban Development, Building and Public Works. Every year, more than 30% of the students choose the Building project. This is run with the Lyon School of Architecture in groups of 3 + 3 students, and aims to integrate the different disciplines for the solution of a single problem, moving beyond technical design to general design and taking into account architectural, sociological, societal and economic considerations, as well as technical aspects. A group of academics and professional engineers and architects guide the students throughout the project that spans over one semester (50% of the semester is dedicated to the project). The 2 other options (Urban development and Public works) also propose this type of technical projects with interventions of professional engineers. Full details of the project are given in a paper presented to the 1st International Conference on Education and Training in Geoengineering Sciences held in Constantza - Romania, June 2nd – 4th, 2008.

7.11.4 Design and Materials

In 2005, INSA Lyon created “Transversal Options”, corresponding to courses of 100 hours that all final year students of INSA can select. One of these is called “Design and Materials”, which relates design ideas to practical construction and manufacture. The objective is to approach problems of design while taking into account real-life constraints such as the market, issues concerning the manufacture and use of materials, and constraints of the construction process. The project involves a strong industrial contribution and has three phases; analysis of existing concepts, a study of construction and manufacturing aspects and the actual construction of models and prototypes, including workshop and foundry operations. During the allocated time, students work on the design and production of a prototype of a Civil-Engineering related artefact. The students work together with an industrial company who would like to produce and commercialize the resulting object.

7.11.5 Grands Ateliers

The Civil Engineering Department of INSA Lyon participates in this innovative structure already described in the contribution of CNISF.

7.12 Laboratoire Central des Ponts et Chausses, Paris

Contact: Georges Pilot gpilot1@free.fr

7.12.1 Industrial Input

The Laboratoire Centrale des Ponts et Chausses, as an industrial laboratory, does not offer study programmes, but it does collaborate closely with Grandes Ecoles to offer an engineering formation which is geared to the needs of Industry. They make and important contribution in hosting students for final year project work, where the specialist equipment and facilities of the Laboratoire are made available to the students and are much appreciated by them. They are also involved in creative approaches to design, particularly in terms of providing architectual expertise and opportunities for students to meet industrialists, see their work and discuss possibilities for employment

7.13 Institut Superieur du Batriment et des Travaux Publiques (ISBA-TP), Marseille

Contact: Bernard Le Tallec letallec@isba.fr

7.13.1 The Syntec Congress

This is an annual meeting for the Engineering professionals, recent graduates and students from 60 engineering schools, organised by Syntec-Ingenierie. It comprises professional workshops on key current topics, such as globalisation, innovation, sustainable development and double training as architect-engineer and debates on topics such as "The place of the women in the engineering", "E-recruitment", "the young graduates and the international scene", etc. These always prove to be highly successful because of the mix of topical subjects and top speakers. The congress also holds a competition, Engineering of the Future, which invites student-engineers to forecast the future by thinking about the possible evolution of sciences and technologies up to 2020. The plenary session always deals with a key general topic, a recent example of which (September 2007) reported on a study of the evolution of the Engineering market and prospects for investment and growth in the coming years. The format of the conference also allows students to meet company representatives to discuss career prospects and opportunities.
http://www.syntec-ingenierie.fr/fr/evenements/rencontresdel8217ingenierie/rencontres2007/programme_5p.pdf

7.13.2 Curriculum Development for Industry

One of the best ways to understand what Industry expects from academe is for industrialists to be closely involved with defining and developing curricula. The School in Marseille is "owned" by a Chamber of Commerce and the vast majority of the teachers are professional engineers working in companies. This means that they are in a position to ensure that the curriculum is finely attuned to the future needs of Industry.

7.14 Middle East Technical University (METU), Ankara, Turkey

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The Construction Industry contributes to the educational activities of the universities only through indirect channels, a number of which are described below.

7.14.1 Accreditation Related Questionnaires

This Department has been accredited by ABET twice in the past and currently is preparing for the third. Input of the Construction Industry is essential in the revision of the course contents to take account of their needs and wishes in shaping the Engineer of the future. Furthermore, it is essential to get the feedback from the employers about the performance of the earlier graduates.

7.14.2 Capstone Design

Experienced practicing engineers actively participate in the instruction and supervision in this compulsory course. Furthermore, design problems assigned every year are usually chosen from the actual practice to familiarise the students with the facts of engineering life.

7.14.3 Hydro-Power Engineering Centre

High level experts from the industry take part in the development and instruction of the related courses, besides participating in planning and execution of research in this particular field.

7.14.4 Technical Electives Given by Practicing Engineers

Several technical elective courses are given by part-time instructors who are experienced practicing engineers.

7.14.5 Summer Practice

This is an old fashioned but rather effective activity leading to direct involvement of the students in the actual engineering practice.

7.14.6 Extracurricular Student Activities

Students often organise various activities bringing students and potential employers together, such as lectures, dialogues, career days, student competitions etc. Some of these may be comprehensive enough to accommodate one or two small workshops involving academia and high level managers from industry.

7.14.7. Collaboration in Research and Technology Development

Universities and leading companies collaborate in performing research and technology development to a certain extent. This research is predominantly experimental, and it generally concerns a specific problem brought by the industry. Universities provide the know-how, research manpower and research facilities and the companies provide finances.

This kind of collaboration has recently increased significantly both in extent and in content after the participation of the country in the Framework Programmes (FP6 & FP7) of the European Union, since most of the programmes require an extensive collaboration of the academia and the industry, including SME's as well as large companies.

Most of the leading universities have established their technoparks in the last 5-6 years, and the advantages a tecnopark presents encouraged the faculty and the companies to further their collaboration in research and technology development.

7.14.8 Consulting

Construction companies knock at the door of the university whenever they need the expertise of the faculty to rescue them from the problem they are facing, usually a problem caused by their deficient engineering practice. It is usually so urgent that the report they require is already overdue. However, putting the joke aside, this is a very important and effective channel of university-industry interaction. It is extremely beneficial for both sides. Industry usually finds an effective and economical solution to its problem, whereas the faculty is kept in contact with the engineering practice so that they are not isolated in the ivory tower. Furthermore, nobody can complain about a small extra income, especially if the professor is getting "celery" instead of a decent "salary" as in the case of Turkey.

7.15 Fachhochschule Oldenburg (now known ad JADE Hochschule)

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7.15.1 Industrial Placements

In Oldenburgh, much use is made of placement in industry during the 7^{th} semester of the Bachelor degree. Students have a placement in a company, either a contracting firm or a design office, during which they gain a lot of practical experience. This programme operates as a joint one between the Fachhochschule and the Company and involves a very close cooperation between them.

7.16 University of Pardubice

Contact: Yveta Linhartova yveta.linhartova@upce.cz

7.16.1 AIESEC (Association Internationale des Etudiants en Sciences Economiques et Commerciales)

This is a very large organisation which operates as a platform for young people to develop their potential. Member organisations come from all sectors of economy. In the Czech Republic, AIESEC has 9 national offices, one them being at the University of Pardubice. It is operated and managed by the students and operates as a consulting centre, organising regular sessions to inform students about Czech and foreign companies. Further information is available from: www.aiesec.cz

7.16.2 Kontakt

This is an event organized by the University of Pardubice (Faculty of Economics and Administration). Its aim is to provide topical information about the Czech labour market. It is organised annually and takes the form of a trade fair. Businesses present their activities and achievements using presentations and display stands, informing the students about job opportunities. Students have no lectures on this day to be able to visit and meet their potential future employers. Further information: www.kontakt.upce.cz

7.16.3 Best Diploma Paper

Every year the Faculty of Transport organizes a competition "Best Diploma Paper". Final paper topics are consulted and then "officially announced" in cooperation with construction companies and other businesses involved in civil engineering who then assess the papers in terms of their applicability in practice. The best papers are then rewarded by the companies.

7.17 University of Patras

Contact: Stephanos Dritsos dritsos@upatras.gr

7.17.1 An Innovative University-Industry Interaction

Every year a Student Conference is organized in the conference centre at the University of Patras, where students present their projects performed in the subject area of Retrofitting Existing Structures. This is a particularly relevant topic for the seismic region of Greece as past earthquakes have demonstrated that a substantial proportion of the existing building stock is structurally deficient. Presentations at the Conference represent the most up to date thinking in the subject area. The Conference is announced to the local industry and practicing engineers and is supported by the Greek Association of Civil Engineers and the local branch of the Technical Chamber of Greece. The three main steel production companies of Greece subsidise the Conference. The Conference is attended by students and practicing engineers from the local region and it is to be noted that the latter actively participate in discussion after presentations.

A Conference hard copy and CD proceedings are given to participants. All presented papers are reviewed by a three member committee and prizes are awarded to the four best projects. Two prizes are awarded by the Greek Association of Civil Engineers while the other two are awarded by a private software company. From six to eight papers are selected for publication in the practical application based Greek Civil Engineering Journal. The criteria for paper selection is on the basis of the most relevant subject matter covering grey areas of knowledge that would be of most use to practicing engineers. All Conference papers are uploaded on the website: www.episkeves.civil.upatras.gr. This website is regularly visited by industry and practicing engineers and is the website of choice in the recovery period after a destructive earthquake, since information on the subject matter is limited exactly at the time when it is in most demand.

Everybody benefits from the University-Industry interaction through the Student Conference. Practicing engineers are kept up to date with the most recent developments, are able to compliment their past education and are made aware of a unique source of information while students have their work constructively criticised particularly in the light of experience and practical application.

7.18 University of Pisa

Contact: Diego Lo Presti d.lopresti@ing.unipi.it

7.18.1 Degree and Profession

This is an opportunity for graduates to meet the professional world and to promote new ideas in Architecture, Engineering Environment, Art, Fashion and Design. It takes place at the Florence World Festival (*Festival Internazionale a Firenze)* and is organised by the Romualdo del Bianco Foundation

Further details:
www.florence-expo.com
INFO: tel. 055 285588 - www.florence-expo.com, info@florence-expo.com

7.19 Universidade do Porto

Contact: Alfredo Soeiro **avsoeiro@fe.up.pt**

7.19.1 Strategy for the Bologna Process

Due to the implementation of the Bologna Process in Europe the Civil Engineering President, Prof. Ferreira Lemos, decided to create a reflection group of eight members. Four were teaching staff from the school, including the president and the academic dean, and the other four were from industry. The members from industry were from recognized institutions and organizations reflecting the wide scope of civil engineering jobs and activities. A plan was devised on the first meeting defining the scope and pace of the group work.

During three months meetings were held and the conclusions discussed using email. The conclusions were directed at proposing a suitable organization of the first and second cycle degrees according to the Bologna process and the future needs of civil engineering. The reasons and conditions for the proposal were also presented in the report. The document was then used for the debate with the rest of the academic staff and for the adoption of the model currently in place. It was a very rich source to evaluate the perspectives of industry about the education expected from the civil engineering school and the knowledge, competences, attitudes and skills from first and second cycle degree holders.

7.20 Czech Technical University, Prague

Contact: Dr. Zdara zdara@fsv.cvut.cz

7.20.1 Student competition: "Hall of the Year"

The competition is organized annually in two categories: Hall of the Year "Academic", for students from home and abroad and Hall of the Year "Junior", for students from secondary professional schools

The aim of the competition is to design and construct the lightest structure of a hall with a given span, subjected to prescribed constraints, using one of three materials, wood, paper and beer mats. Wood and paper models are fabricated in advance, while models made from beer mats are made partly during the competition. The strength of the models is determined by load tests. Progress of destructive tests is monitored using a high-speed camera and concurrently presented by moderator-specialist. Winners receive valuable prizes offered by companies and other sponsors. As a part of competition, the exhibition of the models and associated technology is organised, alongside exhibits and multimedia presentations from and about the partner companies.

Video presentations:
part 1: http://www.youtube.com/watch?v=y6wpy6rq3XY
part 2: http://www.youtube.com/watch?v=o3BcWmBk4js
part 3: http://www.youtube.com/watch?v=c1xWH5bOKkw

7.20.2 Programme for Promoting Industrial Talent

Faculty of Civil Engineering in Prague (FCE) has many useful contacts with renowned design offices and with small to big contractors operating within the Czech Republic. One of the most effective collaborations is with the building Company METROSTAV, one of the biggest companies in the sector. For a number of years, Metrostav and FCE have run a competition for posts for student training within the Company. Concurrently with their studies, the students work at the Company for reduced salary, receive experience and skills training and, prepare his/her diploma project under the supervision of an experienced industrial supervisor. Typically 35 new students enroll each year, giving a total operational cohort of about 100. The training programme is highly appreciated by students, as shown by the ration of applicants to acceptances of 3:1.

The Company accepts students from both Bachelor (with the exception of 1st year students) and Master Studies programmes. The competition is based on academic performance and motivation. The training programme includes the following criteria:

- short/long term training at various positions,
- possible focus on diploma project,
- consultation with Company's professionals,
- allocation of personal supervisor and receiving experience from various fields,
- possibility to receive permanent job after graduating, respecting the training period,
- interesting and demanding work concerning unique structures.

7.21 Riga Technical University

Contact: Juris Smirnovs smirnovs@mail.bf.rtu.lv

7.21.1 Career days

Starting in 2004, Riga Technical University, in close co-operation with industrial companies, has organised "Career days". During these events companies are able to meet and talk to students about job opportunities and what the companies are doing, while students have good opportunities to meet company representatives and begin to make contacts in the profession. This often leads to practical placements for students during their university studies, as well as jobs afterwards. In "Career days - 2008" 47 big companies took part, part of a growing trend for increased levels of involvement. The "Career days" also include high level discussions between company managers and the senior management of the University. These events are a common feature of the university, also taking place in other Faculties. Further details can be obtained from web link below:

http://www.rtu.lv/content/view/522/1029/lang,/

7.22 Escuela de Caminos de Santander

Contact: Amaya Lobo Garcia de Cortazar **amaya.lobo@unican.es**

7.22.1 IDEaS (Integración en la Docencia de las Empresas del Sector de Construcción en la Escuela de Caminos de Santander) - Incorporating Construction Companies' Teaching into Santander Civil Engineering School

The IDEaS program aims to enhance students' training by orientating it towards their incorporation to Construction Industry and to reinforce links between the School and Construction Sector. Leading companies are invited to offer courses with similar content to the training modules they give to their professional engineers. During a period of 6.5 weeks, each Company gives a course on topics such as Management Systems in Construction, Initial management of Construction Works, Construction Works Control, Construction Works Planning and Studies, New Technologies in Underground Construction or Building Concrete Structures. Courses are offered as optional or elective credits (in a range of 2 to 7.5 credits per course) as a part of the final year of study, and also include site visits. The program is complemented by five-month professional internships in the Companies, within the Spain or abroad. During this period students are encouraged to develop their Final Project or equivalent technical work.

7.22.2 ENEIC (Encuentro de empresas de ingeniería civil - Meeting Civil Engineering Companies)

Every year students organize a two-day meeting of the professional sector in the School, to provide students with an overview of career options and to get them closer to the professional world, facilitating their future employment. Civil Engineering Companies, Professional Institutions, University Research Groups and local Administrations are invited to present their activities within an intensive program of short talks, a specific publication that gathers descriptions of all participants in the meeting, and through personal interviews with the students that visit their exhibition stands. Students' attendance and active participation in the meeting are acknowledged as elective credits.

7.23 Technological Education Institution, Serres

Contact: Errikos Mouratidis erikm44@hotmail.com

7.23.1 Industrial Training

During the last (8th) semester of their studies, students undertake a 6-month practical training placement in the public sector or a private company. During this period, many are occupied in building sites, where they gain experience and develop skills in working with hand tools, while others work in design companies, also gaining experience which they do not get from their university studies.

7.23.2 Design Dissertation

At the end of their studies, students present a dissertation thesis supervised by professors and specialists, the basis of which is the complete concept and design of a special structure. Students have to start from land surveying, deal with the relevant authorities, learn the building legislation, conceptualize and design the structure, solve specific problems, draw up the budget and the organization of the building site. The whole project has to be based on the knowledge obtained during the students' studies, and a research aspect is also required.

7.223.3 Interaction with Professionals

Once a year, professionals (graduates of the Civil Engineering Department) are invited to present information about their professional work to the students, discuss with professors about the difficulties they had when they started working and give suggestions about improvements and developments of the curriculum. During these sessions, students have the opportunity meet professional engineers for discussion and advice. The Careers Office is also involved and organizes similar events.

7.24 Tallinn University of Technology

Contact: Tiit Koppel tiit.koppel@ttu.ee

The mission of the University is to support Estonia's sustainable development through scientific creation and science-based higher education in the field of engineering, technology, natural and social sciences. In response to its mission statement, the Faculty of Civil Engineering has established a number of different examples of co-operation with Industry.

7.24.1 Industrial Representation

In the Academic and Departmental Boards there is a long tradition that the external members are invited from different Companies or Professional Institutions within the Sector. On the one hand, it gives publicity to the decisions and discussions within the University, while on the other hand the representatives of Industry can address their problems directly to the academic staff. Of course, at the same time the academic staff are also involved in different decision-bodies formed by the Industry. In parallel to the direct links with the business community there are also the advisory links between the Faculty and the relevant Ministry (of Economic Affairs and Communication) responsible for Construction Sector. In practice this means that academic staff are involved when legislation is drafted and that they participate in all the working commissions of the National Standardisation Board.

7.24.2 Guest Lectures from Alumni

It is common for former students of the Faculty to be invited to give guest-lectures. They are also involved when the topics for MSc theses are proposed – the idea is that the majority of the topics of the theses should be industry based.

7.24.3 Cooperation Agreements

TUT has introduced the practice of signing co-operation contracts with the advanced companies from different Industrial Sectors. These contracts foresee various forms co-operation, including research and testing, but also possible Company sponsorship, which is mainly used to invest into equipment used in the laboratories of the University. Currently there are three contracts of this type signed between the Faculty and Companies in the Construction Sector, providing equipment and scholarships.

7.24.4 Careers and Company Awareness

The Faculty also organises meetings with the leading Companies, in which representatives outline its activities, work practices and working conditions to students. This is similar to a number of other institutions, although on a smaller scale, inolving only 1 - 3 companies. The Faculty also has a number of has co-operation agreements with some companies the most recent being the Frame Contract with AS SWECO, a 4 year agreement in which the company guarantees practical training for students and provides a fund for scholarships.

Still one has to keep in mind – the success of construction sector is greatly dependant on the general economic climate. When the economy was booming the companies of the construction Industry could easily provide placement for the graduates and training possibilities for the students. This situation has changed by today, but these traditions will be continued, for sure. In 'good' times about 85% of students were working in the Civil Engineering Industry. This, of course, had its negative feedback to the academic performance of the students, but gave immense practical experience that has been successfully used during the academic studies.

7.25 Universitatea Politehnica Timisoara

Contact: Iuliu Dimoiu idimoiu@ceft.utt.ro

7.25.1 Building Technology in Practice

Within the field of Building Technology, part of the lecture programme is provided by companies and is based on the requirements of site work. It includes material on site organisation and also gives students the opportunity for site work for students. Responsibility for the module is shared between the University and the Company, with staff from both playing a prominent part.

8. NATIONAL 'STATE OF THE ART' REPORTS

For this section, national representatives were asked to submit reports outlining the current state of the interaction between Industry and Academe, based largely on existing material rather than on further surveys. The idea here is that in most countries, there is already in existence a significant literature covering this topic, which has been compiled by technical and educational journalists, Professional, Industrial and Government bodies and other interested groups, and it is therefore not necessary to undertake further studies. Rather, it should be quite possible to understand the current situation by looking at and summarising the existing literature. All countries were asked to submit material, in a standard format, comprising sections dealing with skills shortages, quality and standards, the role of government and the current economic situation. Replies were received from the following countries:

Czech Republic; Denmark; Germany; Finland; Greece; Italy; Poland; Portugal; Turkey; United Kingdom

The key points raised in these reports are summarised here and the full reports are available in Appendix 2

8.1 Skills Shortages

(CZ) Staff/skills shortages are seen as an ongoing problem and a limit to growth, particularly in areas such as building, project managers, contract managers and craftsmen, including carpenters, building services and electricians. The total figure is as high as 5000. The problem tends to be tackled by bringing in workers from other countries, which is fine for CZ, but simply moves the problem elsewhere. The key reason remains the relatively small number of students who wish to study for technical professions.

(DK) For many years, unemployment for engineers has been very low, and there continues to be a shortage of personnel, especially in road and rail building. Other shortage areas include civil works and infrastructure planning, climate adaptation, and energy in buildings. Recent studies suggest that provision of trained engineers will be satisfactory in the coming years, with the Public Sector actively seeking to attract engineers again.

Industry complains that the output from universities is too small, but the key limiting factor here is the willingness of students to enrol in technical courses. One recent approach has been to develop a scheme of industrially supported PhD grants as a mechanism to attract the best students and raise the profile of the Industry. This seems to be working well.

(GR) Greece has traditionally had an oversupply of graduates for industry, due to the high esteem in which an engineering qualification is held. However, there is an increasing belief that courses are too long, not sufficiently vocationally-orientated.and that graduates are often over-qualified for the jobs available. Thus there is a strong feeling that university curricula need to change. More emphasis is needed on law, business and management, as well as some ‘non-classical’ areas such as energy and environment

(P) Internationalisation means that employment levels for Portuguese engineers are good at present. Supply and demand are reasonably well in balance, and unemployment seems to be limited to graduates of the less highly-regarded universities. Demand for places on engineering courses remains high and the profession remains well respected as a quality profession. .

(UK) The UK has Industry has also experienced skills shortages over a number of years, and a time when the workload of the Construction Sector is very high (Olympics, Crossrail etc) this is a significant problem.

8.2 Providing the Missing Skills - The Skills Pipeline

(CZ) Although graduates are now considered to be more independent and self-confident, they are still considered to be lacking in communication skills and knowledge of law and business economics

Training needs (DK) are generally covered by the provision of CPD within the Industry, with the University sector providing training in fire design, construction planning and business management. Areas where skills enhancement is needed include energy efficient buildings and facilities management.

(DE) German university professors are quite distanced from undergraduates, focussing their main interests on Lehrstul (research groups). The situation is better in Fachochsule, though here, the problem is different, with many students and not enough staff. The split in the sector is quite clear, with Universities focussing on R and D, the Fachhochschulen on professional requirements.

Placement problems are increasing, which means that it is more difficult for students to get the industrial experience which the sector says it needs.

There is a downturn in numbers coming into the Industry, due to the reduction of students wishing to study technical subjects, perhaps due to negative headlines about the reduction in building activity. The consequences are clear, with companies finding it increasingly difficult to recruit the people they need. This lack of qualified personnel is likely to have a detrimental effect on economic growth.

(GR) Numbers of students wishing to enter civil engineering studies are bearing up well, and civil engineering is still highly regarded as a profession in Greece. However, the type of employment on offer is now changing. Large scale spending as a result of the Athens Olympics and EU investment has now fallen and there is a growing tendency for short term employment contracts and a feeling of insecurity.

(IT) In Italy, production of graduate engineers seems to be sufficient for current needs, and most new graduates do go on to establish themselves in the profession, albeit perhaps not earning the level of salaries they feel they should. This suggests tht the Italian labour market is not as competitive as in some other countries.

Computing, languages and a solid preparation in the key technical subjects are required, but the need for PG qualifications is considered to be low for labour market requirements, even though many students wish to study at PG level.

However, the numbers of pupils entering universities is falling, though engineering figures remain stable.

(T) Civil engineering is not so popular with young people wishing to go to university, probably due to perceptions about salaries and working conditions. In addition, students are often placed in programmes which they have not chosen, meaning that many engineering students are not following a subject of their own choice.

(UK) In the UK, one of the key problems is getting young people interested at a sufficiently early age, which will allow them to make the right subject choices at school. The image of the Profession is also something of a problem. Many other professions are considered to be much more attractive by young people.

8.3 Quality and Standards

In a number of cases, questions about the standard of graduates students entering the Profession have been raised, as well as whether standards of professional work are as they should be in all countries.

(CZ) Pressure of work and shortage of staff are leading to corner-cutting and a falling off in the standard of work, leading to suggestions for enhanced quality management procedures for the Industry. There are ongoing discussions about the need to tackle this problem with a programme of CPD.

(DK) A programme of national accreditation was introduced in 2007/8. This is putting considerable strain on resources in Universities and it is still very doubtful whether the process will lead to an enhancement of quality.

(P) The system for quality and standards is considered to be effective, with the Ordem dos Engenhieros operating well and ISO now well established in the Industry. Where they do occur, problems tend to be found in small building companies rather than civil engineering firms.

(T) Quality needs to be increased. The number of under-educated and barely adequate engineers is worryingly high. The Chamber of Engineers is working on this, and continuing education is seen as one way forward, even to the extent of making it mandatory for the renewal of an engineering licence to practice.

(UK) In the UK, standards are broadly considered to be good, but there is some concern that this is nsot uniform across the sector.

8.4 The Role of Government

Perhaps not surprisingly, the role of Government is financing universities is considered a key topic, along with its role in providing a stable economic and regulatory environment in which the Sector, both academic and industrial, can operate.

(CZ) The Government's main role concerns finance. Universities are facing a significant financial crisis in the Czech Republic, which will lead to cutbacks, redundancies and closures, with concomitant effects on the output for Industry.

(P) A charge of 0.5 % of the contract value is now being levied on companies which win government contracts, to be invested in research. This could be extended, with other companies investing the same amount in universities, for mutual benefit. A good idea, but how likely is it to come abut?

(T) Universities have been established without provision of suitable staffing and infrastructure levels.

The industrial and infrastructure requirements of the country are still far from being met, so the need for engineers will continue. Seismic retrofitting is important here, though only part of the story. Substandard work is considered to be a problem in the Industry, though not as a result of the education system. Thus, is there a role for Government in controlling this? Working with Industry?

Avenues for enhanced collaboration include the development of technoparks, and enhanced opportunities for academic staff to undertaking consulting for industry, both to solve problems and to enhance mutual understanding.

(UK) One of the main concerns in the UK is for the Government to provide a stable planning, legislative and regulatory platform for Industry, which will enhance long term investment. The University sector would also like to see a stable and sufficient level o funding for Civil Engineering education, though it recognises that this is unlikely to be achieved in the current economic climate.

8.5 The Role of Industry

(CZ) There is also a belief that they are not really ready to make an immediate contribution to the industry, because of lack of practical and work-related preparation (whether this is a valid criticism by Industry of new graduates is another matter). These problems are considered to be due in part to the lack of practical experience and orientation of university staff

(P) Student fees levels are seen as a type of subsidy for Industry, with universities seen as a source of cheap labour. This makes Industry less inclined to get involved with the University sector. This general view applies less to PG work, where University-Industry cooperation is more common.

Companies do not invest in research, which is seen as a cost, not an investment. This means that PhD qualifications are not recognised and respected

Industry needs to demonstrate a willingness to accept incompletely prepared graduates. The University Sector can educate graduates in the key fundamentals of engineering science and develop some key skills in the students, including IT, communication, critical thinking and a problem solving attitude. It can also inculcate an 'engineering state of mind'. However, it cannot produce graduates who an always be expected to operate effectively as an Engineer from day one. There is a strong need for Industry to provide the sort of detailed specialist training matched to its needs and probably much better provided on the job. The need for this life long learning has now been widely recognised Obvious examples of this might include construction logistics, project management, full-life costing, civil engineering as a business, professionalism in working life, etc.

(UK) One of the key issues is the need for Industry and Academe to work in a complementary way. Each has a vital role to play in the formation of Engineers. The first provides a sound education in the fundamentals of engineering science and instils an attitude of creativity, problem solving and what is termed an 'engineering state of mind'. The second is where the well-educated by inexperienced graduate learns about real engineering logistics and applies his or her knowledge in the solution of real engineering problems. Both parties can do more to work together on this.

8.6 The Current Economic Situation

The survey was conducted very shortly before the economic downturn hit Europe hard in the fourth quarter of 2008, so this section is not really an up to date account of the fate of the construction sector across Europe. Nonetheless, some interesting points arose which are noted below.

(CZ) Although 2008 saw a decrease in the number of government contracts for civil engineering, their total value was higher, a pleasing development. However, more recently, there has been a significant downturn in domestic and commercial building programmes and particularly in civil engineering infrastructure programmes, especially roads and traffic.

(DK) Denmark has seen a considerable down turn in home building, with staff being laid off, but there is still the recognition of the need to carry on with large infrastructure projects which are currently under way, including road and rail projects.

(DE) forecasting demand is very difficult, due to the economic situation

(GR) Within Greece, both the public and private sectors are now facing difficulties as a result of the economic downturn. The immediate future looks tough, but more optimistically, it might be seen as a good opportunity for the sector, particularly the university part, to make a shift away from some of the more traditional and classical topics towards those which are likely to be more necessary for the future.

(P) In Portugal, investment in public works is seen as a way out of the economic recession. However, investment in universities is falling, which suggests that they must seek other sources of funding to maintain their positions.

(UK) Construction is being hit hard, but at the present time, the impact is more significant for building than for big civil engineering infrastructure projects, some of which, such as the Olympics, have major national significance and prestige, and as such, are not likely to be cancelled or slowed up. However, some private organisations are taking decision to defer major projects if the relevant planning cycle permits.

8.7 Other Points

The openness (or otherwise) of the EU to the mobility of professionals is considered to be a problem, both in terms of non-EU people seeking work in the Czech Republic and Czech citizens being able to work elsewhere in the EU, especially in Germany. This is a matter for the Profession and the Government to tackle.

(DE) Following the introduction of the Bologna Process, there is some doubt about whether first cycle graduates (Bachelor) are suitably qualified for the job market, with students themselves also feeling the same uncertainties. This of course is exactly the opposite of what the Bologna Process is trying to achieve. However, recruitment statistics suggest that students are happy with the Bachelor system. There is clearly a conflict here.

(IT) Italian engineering education does not link in well with the perceived needs of industry, especially at first cycle level, and qualifications, especially at PG level, and not widely appreciated by the labour market.

(P) Civil Engineers are not good a presenting a positive image of their profession. This needs to be improved and would presumably have the spinoff of raising profile amongst

9. QUESTIONS AND TOPICS FOR FURTHER STUDY

During the final stages of the compilation of this report a number of important questions related to the main topic of this report arose. It was not possible to review these in detail because of the constraints of time, but the

General Assembly did debate them and a brief summary of the prevailing views are given below.

9.1. The Bologna Declaration

Does the Bologna system actually produce graduates at the first cycle who match the needs of the labour market?

At the time of writing (December 2009), this remains a very open question. Within Civil Engineering education, there is still a lack of compliance with Bologna and a strong feeling in favour of national traditions of Engineering Formation. Some countries, notably France and Greece, do not accept Bologna and the UK, as ever, remains ambivalent. Even in countries which are much more compliant, such as Germany, there are differences of opinion. If there is a consensus, it is that the Construction Sector needs a variety of educational preparation to cover its varying needs and that Bachelor and Masters level qualifications still have a place. There will always be the need for technician Engineers, but that in the future, professional Engineer will need to have at least a Masters (Bologna Level 2) qualification. One interesting idea to emerge from discussion is that the first cycle qualification might come to be seen as a pause, to allow students to break off for a while before deciding whether to go back for a second cycle qualification. This would fit well with the increasing importance paced on lifelong learning.

9.2 The PhD Qualification

What role does the PhD have in the education process for Industry?

There is a view, quite widely held, that the PhD, while inherently valuable, is not necessary for work in the Construction Sector. Some see the qualification as a high level technical specialisation which can have an important role, but many see it essentially as the way in which academics are trained. However, others see it as a way of developing the really innovative and critical thinkers who will be essential to the Industry as it faces the challenges of the 21st Century. It is also recognised in some quarters that the PhD is changing. Increasingly, PhD studies go beyond the study of a particular technical problem to include generic training which will assist students in later industrial careers, and in some cases, such as the EngD Programme in the UK, students spent much of their time in Industry, working on industrial problems, while being registered for a higher degree.

Again, there was no clear consensus on this matter, beyond recognition of the value of a PhD for its own sake, and an appreciation of the high level of critical analytical and creative thinking it can produce. However, there was agreement that the PhD should be allowed to flourish and not become over-regulated by educational bureaucrats.

9.3 External Teachers

Increasingly, external (industrial) staff are used to in providing industrial contributions to teaching. As QA pressures increase, is there a possibility that QA agencies might wish to vet external, non-pedagogically trained contributors to course design and delivery? Might this become a problem?

This question was posed by UK delegates, some of whom are wary of the extent to which their national QAA procedures are becoming over-elaborate, overly-bureaucratic and generally unhelpful. Although this external teaching input is much to be welcomed as a means of linking theory with practice and making courses more relevant to the needs of Industry, there is a potential problem when it comes to quality assurance. As this phenomenon becomes increasingly prominent, it may prove necessary to do more to bring external teachers into the quality process. This may mean an increased need to give guidance and direction to external staff about the educational, as opposed to technical, contribution which they make. During a brief debate, it was recognised that this might be a problem; indeed, this had certainly proved to be the case in one academic Institution. However it had been dealt with successfully and on the whole, members did not consider that this was likely to prove to be a major issue.

9.4 Quality of Graduates

Is there sufficient confidence in the quality of the graduates we produce, and their ability to adapt to professional life? Are we sure that the Industry is sufficiently confident in its own professional standards, which may be coming under pressure because of the current economic climate?

There was little time in the final session to debate this topic. However, it has to be said that some national reports did express concern about it, perhaps not surprisingly, given the large increases in the proportion of young people now going to Universities compared to 20 years ago. This report is not in a position to say whether this is a valid concern or simply one generation lamenting that things are not as good as when they were at University.

9.5 Student Preferences and Choices

One recurring problem in terms of skills shortages is the apparent unwillingness of potential students in many countries to choose technical *subjects. This raises again the issue of the attractiveness of the Profession, both in the way the education is delivered and in the career and life opportunities result from such choices. What can we do about this?*

Again, there was no time to debate this question. However, it is interesting to note that it is a concern which was raised in the deliberations of Working Groups C and F, and continues to be of concern to Working Group H. /Clearly, some things do not change much.

10. SOME RECOMMENDATIONS

On the basis of what has been set out in this report, a number of recommendations can be made, and these are listed below.

- The Common Platform. EUCEET cannot lead on the development of a Common Platform, though it does have an interest in seeing something develop and in playing a role in its formation
- Quality Badge. Neither EUCEET nor the EUCEET Association is a position to take a lead on the development of a quality badge for Civil Engineering Education across Europe, along the lines of the EURACE award in Chemistry. However, individual members are able to play a role in such a development, as technical and educational experts, acting in an individual capacity.
- Industrial Workshops. EUCEET supports the continuing dialogue between Academe and Industry via a series of Workshops on topics of mutual interest, but believes that these are best organised via existing networks and contacts, since these are best-placed to respond to local, regional and national concerns. EUCEET can play a role as an overseer and disseminator.
- Synergies with Industry and the Profession. This report has compiled interesting and useful information about the value Universities place on their current links with Industry and provided some examples of innovative ways of working with Industry, which are commended to the membership. :

11. CONCLUSIONS

In general, there are very good synergies between Industry and Academe within the domain of civil engineering education and training. Contacts are very well established, have operated for many years and continue to develop. Industry is generally very keen to be involved in the work of the University sector and their involvement is welcomed by students and university staff. The contributions of the two sectors have to be complementary. Universities aim to produce graduates who are well-grounded in the fundamentals and who can think for themselves and solve problems. They aim to produce people with a sound education but an engineering ‘state of mind’. Companies bring those professional aspects to the table which it would not be reasonable to expect from university education. Engineers have to be problem solvers and this ability derives from practical experience as much as from a sound engineering education. This can only come from on-the-job training which young engineers can only gain from working in the real world. It is vitally important that these complementary, but distinct aspects of the formation of an Engineer are understood.

To summarise, Universities and Companies need to work together to produce the Engineers of the future and in the main they do this well. Universities should continue focus on the fundamentals, while helping their students to develop skill and at the same time inculcating the engineering ‘state of mind’. Industry should then take the well-formed but essentially raw and inexperienced graduates and mould them to company needs by a programme of training and supervision which will allow them to develop into a real Engineers.

APPENDIX 1:
LIST OF PARTICIPANTS

The following members have taken part in discussions and correspondence which have contributed to this report.

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APPENDIX 2: NATIONAL 'STATE OF THE ART' REPORTS

1. National Report for the Czech Republic

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1.1 Skills Shortages

[1] June 2008
Shortage of workers is threat for global civil engineering.
Shortage of workers threats the Czech and global civil engineering as well, limits its growth and increases its expenses. Builders miss mostly civil engineering and project managers, craftsmen, specialists and contractual managers. In the Czech Republic and in the world the companies solve the problem mainly by acquiring the workers from abroad. This follows from world-study of consulting company KPMG. Positively the greatest shortage in global civil engineering is in civil engineering and project managers, claimed in about 74 % of addressed companies. In 34% of addressed companies is shortage of craftsmen, specialists and contractual managers while 30% has shortage of civil engineers. Czech President of Society of contractors in civil engineering told earlier, that on domestic market is shortage of approx. 5000 people.

[2] February 2009
In accordance with inquiry made in January and February 2009 on internet Portal Spravnykrok.cz among small and medium-sized civil engineering companies is the main shortage in the area of civil engineering in particular in civil engineering electricians, where the excess demand/supply is more than quadruplicate. Double demand is for simple civil engineering workers, joiners/carpenters and foremen. Civil engineering companies, on the other side, currently do not demand more qualified employees like engineers and site managers. In January the number of applicants in these categories was twofold. In January in accordance with absolute numbers of the Portal mainly foremen and simple civil engineering workers were looking for jobs and, and the main demand was for civil engineering electricians, simple civil engineering workers and foremen.

[3] April 2009
From year to year, the desperate call from corporate sphere sounds: we have shortage of engineers. Branches, on which the Czech Republic was proud at one time, weaken from lack of interest of young people to study engineering fields of study. In accordance with Institute for information in education, the Czech Universities enrolled this year 17.000 more students than two year years ago.

However, in technical sciences the number increased only for 2.400 students. This is in spite of the fact that the technical universities tried to attract as much applicants as possible through various scholarships or sponsorships from companies. However, without any success.

1.2 Quality and Standards

[4] July 2008
Shortage of time to elaborate high-quality design documentation, limited financial means, poor choice of contractor of civil engineering works and supervision (in many cases the supervision is made by the contractor himself) are the main roots of low-quality structure execution. If the risk factors are cumulated, the malfunctions may be forecasted with the greatest probability. Therefore, the new concept of quality management and quality assurance is necessary, because the current management is often insufficient. It is inevitable to project the revolutionary economical changes into system of education, namely through open credit courses, possibly in cycles of CPE (continual professional education), and professional seminars. Recently, for example, in German universities have arisen departments focused on new models of company and site management and civil engineering technologies. In the Czech Republic little attention is devoted to such questions in the contemporary curricula.

1.3 The Role of Government

[5] May 2009
At present we can see that the current graduates, mostly from universities, are different from former ones. They are more independent (usually they were employed during their study), self-confident and courageous in the sense to take a risk. However, what they miss, and it is not their fault, are abilities to assert oneself in real operation and quick adaptability for a work in the company. The roots may be found in several principal fields. The university professors are frequently separated from practice. Either they did not work in real surroundings at all or left it long ago. They know modern theories, new materials and technologies but they can not pass on to the students the experiences from practice. Even the content and extent of the courses does not correspond to demand of practice in the full. The graduate of a university should be prepared for a job in various technological plants. Monothematic education and perfect knowledge of strictly limited discipline only complicate their use in practice. What miss the graduates? They have nearly no preparation for communication with people, managing of work teams, ability to acquire natural authority due to knowledge, they have little knowledge about law, practical economy from the view of pricing and financing of construction and little knowledge about criminally legal consequences of some negligence acts.

Another important thing is to speak about bachelors. Accordingly to law, they are university educated people. However, their use in practice is very limited which is clear from little contractor's interest to offer them a job.

[6] April 2009
The Czech Universities miss 1.500 millions CZK, redundancy is threatening. Government owns to the Czech Universities 1.500 millions CZK for their educational activities. In case, the Government does not succeed to settle the debt, rectors will have to start economize. For example, they will fire employees or lower expenses for technical operations. It means to lag behind the world in technical equipment, told Rector of CTU in Prague. The proposal of Ministry of Finance for this year was initially intended with deficit of 2.500 millions CZK.

1.4 Impact of the Current Recession

[7] February, 2009
Today the Czech Statistical Office published last year results which looks in the flooding of bad numbers, for which the economy starts to be used in the last period, as pleasant surprise. In spite of the fact that in 2008 there were less civil engineering contracts, their value was 17.4% higher in comparison to 2007, altogether more than 309.000 millions CZK. However, analysts raise a finger with warning, because the economic crises does not avoid not construction sector and the accomplished projects are rapidly decreased. Results of civil engineering sector are good especially due to public contracts. Their amount was interannually higher nearly for one half and amounted for 182.000 millions CZK. On the other side, in accordance with bank analysts, the contracts for construction of apartments and commercial buildings direct sharply down. After years of massive construction of apartments and commercial objects a recession and slump is coming.

Demonstration of crisis in civil engineering sector may be illustrated by results from last quarter. There are 27% less contracts for new flats. Even worse is situation in contracts for non-dwelling industrial contracts, were the fall is 44.7%. The slump is mainly in more demanding structures of traffic infrastructure. In comparison with the last year's contracts the average value of the new once has been increased for more than one third, to 4.3 millions CZK. Especially the public contracts are noticeably more expensive. In the last quarter their average value was 9.3 millions in comparison to 2.5 millions in private sector.

[8] March 2009
The economic crisis in the Czech Republic decreases the number of contracts, especially from private sector. This was confirmed from an inquiry among the

leading civil engineering companies. It has to be said that only 2 years ago the contractors had to refuse the new contracts because they did not kept them up due to construction boom. In the competition some of the companies were said to underbid the prices, to be under the real spending. Such approach may result in relatively short period to not paying to the first contractors with following bankruptcy of these companies. Contractors are also afraid of postponing or even stopping of some contracts. Economic crisis may supposedly lead some companies working mostly for private sector to public contracts. At the same time to accept smaller commissions, which were formerly not attractive. The last year global civil engineering works in the Czech Republic according to Statistical office increased for 0.6%, what means the lowest increase from year 1999.

1.5 Other Points to Note

[9] August 2008
Opening market of European Union to authorized persons (chartered engineers) is without doubt the basic problem to be solved by the Czech Chamber of Civil Engineers. This belongs to the primary activities of the Chamber. One of the big debts of the Chamber to its members is a fact, that authorized person is not accepted in e.g. German speaking countries and on the other side the market of the Czech Republic is relatively open to foreign persons. The Chamber itself can not solve the whole problem of closed or open job market of EU, but at least could prepare for its member meaningful information on current situation. The colleagues from abroad should be involved, especially from Germany, together with governmental deputies to discuss this situation, because it is non-correct to all our authorized persons.

1.6 References

The above was based on the following articles and commentaries:

1. iHNed.cz (electronic newspaper), 16. 4. 2009
2. Konstrukce (Structures), No.2, 2009
3. CTK (Czech News Agency), 26.06.2008
4. Stavebnictvi (Civil Engineering), No. 7, 2008
5. Stavebnictvi (Civil Engineering), webpage, May 2009
6. CTK (Czech News Agency), 16.4.2009
7. CT24 (Czech Television), 26 February, 2009
8 iHNed.cz (electronic newspaper), 16. 3. 2009
9. Stav

2 National Report for Denmark

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2.1 Manpower Supply for Industry

During the last 25 years it has been a general perception in industry, among politicians and the public that there is a unfilled need for civil and building engineers, and indeed the unemployment rate is very low even in these difficult times (2009). In particular in the field of road and rail construction there is an unfilled gap, which has been identified with deteriorated research and innovation in this field in universities. However some studies (by the contractors' organisation, Dansk Byggeri) suggest that the number of academically educated civil engineers will not be to low in the coming 10 years. Especially the public sector is actively seeking to attract engineers again after a period of more focus on economy and general competences among public managers.

2.2 Quality and Competences of Graduate Output for Industry

During 2004 the academic level of the university educated engineers was dramatically (and to some extend unjustified) criticised by the Association of Consulting Engineers. Partly as a response to this criticism the Technical University of Denmark established a series of networking events and workshops (aftagerseminarer) where employers were invited to discuss and influence the curriculum and pedagogical element elements of the education. As a result of this activity the educations at DTU has been revised and the Bologna 3+2+3 system introduced. For the bachelor of engineering programme at DTU the CDIO system has been introduced, see: http://www.cdio.org/ . As a result of these and other initiatives the overall repute of the young newly educated engineers has risen among employers and in the public.

2.3 Skills Shortages

The following areas have been highlighted as areas within civil and building engineering where there is a strategic skills shortage:

- Civil works and infrastructure planning
- Climate adaptation, planning an management
- Building energy and installations

The industry has responded to the skills shortage by sponsoring courses and professorships in rail construction and (from 2009) hydraulic engineering.

2.4 Difficulty of Finding and Retaining Suitably Qualified Personnel

In the boom up till 2008, Industry was headhunting students during their thesis work and even PhD students were head hunted out of their projects. This has slowed down since 2009.

Industry complained that output from universities was too small. However the output is mainly governed by the number of interested students, since admission has in essence been free except at DTU where admission is restricted.

It ma be noted that the number of students applying for entry at DTU has risen from 1600 in 2002 to nearly 3000 in year 2009. The rise in applications has been particularly high for civil and architectural engineering where admission has been restricted by capacity and regulated through admission grades since 2006. In 2009 the number of applications was twice the number of admission places.

An interesting finding has been that some firms, both consulting and contractors, during the last 5 years have begun using industrial PhD grants as a recruitment mechanism. Firstly they attract the best students and produce targeted knowledge for their own company, secondly they raise the esteem of their company among other students and thirdly they participate in raising the esteem of the entire business in society.

2.5 Future Training Needs

The training needs for already educated engineers are generally covered by short courses provided by the employers and private knowledge companies. Formal competence giving education (Master programmes for professionals) is offered by the universities in the following fields:

- Fire (functional based design)
- Construction Planning and Management
- General Business Management

It is envisaged that training in the future will include master programmes in:

- Energy efficient building
- Facilities Management

2.6 Perceived/Required Changes and Developments in Engineering Education

Since 2001 a number of changes have been implemented:

- 2001: The Architectural Engineering programme was opened
- 2002: Arctic Technology programme (starting with 3 semesters in Greenland) was opened
- 2005: The Bologna was adopted (3+2+3)
- 2007: CDIO was adopted for BEng programmes

- 2008: A number of synthesis/design courses were included in the academic CE programme.

National Accreditation of all BEng, BSc, and MSc programmes was initiated in 2007/8. The process is putting a strain on resources at universities. The present author is seriously in doubt if the accreditation process will increase educational quality.

The number of female students is now 50% in Architectural Engineering and above 30% in Civil Engineering at DTU. The present author advocates that we maintain a gender balance in this range, since experience in other education programmes (medical and veterinary science) has shown that male students flee programmes with an overweight of female students.

2.7 Impact of the Current Recession

The current crisis has increased the number of student seeking admission to civil engineering even more.

The industry particularly contractors building homes have laid off engineers, however it seems that he slow down to some extend is balanced by an increase in need for engineers to realise the large infra structure projects currently under way in Denmark: The Fehmarn Belt Link between Denmark (Copenhagen) and Germany (Hamburg), Copenhagen Metro, A number of planned motor ways, A number of new/renovated rail lines, off shore wind parks, large investments in regional hospitals.

2.8 References

The following reports (mostly in Danish) may be consulted for further reading.

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2. Akademiet for de Tekniske Videnskaber: *Fremtidens byggeerhverv i et globaliseringsperspektiv*, pp. 33-41, ISBN 978-87-7836-047-2. Denmark 2009.
3. DTU og Vejdirektoratet: *Fremtidens veje? Bedre veje gennem forskning og uddannelse.* Januar 2008.
4. Møller, J.S. and M. Geiker: *Bygningsingeniøruddannelsen på DTU – med speciel vægt på beton som byggemateriale*. Presented at Dansk Betondag (in Danish) 15 Sep. 2005.
5. Møller, J.S.: *Strategies for Research, Education and Innovation, A University's Considerations*.
6. ECCREDI and E-Core Conference, B4E, Building for a European Future, Maastricht. Proceedings Vol 2 pp. 377-389. Oct. 14-15 2004

7. Erhvervs og Boligstyrelsen: *Byggeriet i Vidensamfundet – analyse og anbefalinger fra udvalget vedr*

3 National Report for Finland

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This data set is based mainly on the "National Report on Workforce Education and Skills at the Construction and Real Estate Sectors 2008" (later referred as Report), compiled by the Association and Helsinki University of Technology, including some more recent statistical data.

3.1 Manpower Supply for Industry

The total number of MSc Civil Engineers in the workforce is estimated to be 5800 persons, while the whole population of Finland is approximately 5.2 Million inhabitants. The age structure of the employed is weighted to the age groups of 36 years and older, especially to those close to retirement (51-65). The recession of the early 1990s can be seen clearly as the small age group of 31-35 years. The intakes for the universities were cut roughly by 40 per cent in 1993-94, and a majority of graduates of the period 1992-1996 were employed to other sectors. Only few have returned.

The number of retiring civil engineers is estimated to be about 170 persons per year for the period 2008-2017. (Image 1)

Since 2001 the university intakes have been relatively stable, about 220-250 persons per year in two separate University units (Helsinki and Tampere). Civil engineering has also gained popularity year after year, as the number of primary applicants has grown to about 600 per year. However, the university dropout rates are still high, about 30 %. Thus the number of graduates can be estimated to be 150-170 persons per year at least till year 2015. Even though the young persons do not directly replace the experienced, the total number of graduates can be seen to be roughly on the right level. (Image 2)

Currently the number of graduates is first and foremost sensitive to keeping the university intakes stable and lowering the dropout rate. From the industry point of view, structurally a major factor is the division of work between M.Sc.:s and B.Sc.:s – the latter graduating from several Polytechnics.

The Report included a questionnaire on the employers' motivations to recruit in the close future or not. Major factor was the generic economic outlook. Remarkable factors were also staff retirement, company market share and demand for new skills. The results can be interpreted so that a grim generic outlook prevents recruiting, whatever the retirement rate.

3.2 Graduate Quality, Competences and Skills Shortages

The Report included also a questionnaire on the expected competences of young recruits. In addition to the 148 employers who answered, an interview round of 11 HR Directors and CEOs of leading companies was done.

Out of the two largest fields of skills for the young recruits, retrofitting was seen as 20 % more important than greenfield construction. This opinion preceded the fact that in 2009, for the first time in Finland the retrofitting industry volume grew larger than greenfield production.

When asked about the average skills of young recruits on a scale 0-5 (5 being excellent), the employers gave them the grade 3,7 (good plus, that is). This was the average for all recruits independent on the level of their education. University-level civil engineers scored 4,2. Open question on missing competences produced a longish wish list, but the small number of those answering does not provide statistical evidence.

The list on specific knowledge that graduates are typically missing included e.g.

- Energy efficiency and moisture control
- Eurocodes
- Automation
- Building Information Modeling BIM
- Bridge design, especially retrofitting
- Geomechanics and rock construction
- Railway design and construction
- Structural design.

Out of more general skills, both current employees and future recruits were considered to need further training on

- Project management
- Procurement, contracts and legislation
- Leadership skills
- Development skills
- Presentation skills
- Finance and economics
- Customer skills.

Both of these lists apply for all young recruits, but they are evidently true also for the subgroup of university graduates. They are also at least partially misleading, as in his or her early career a young employee typically needs only with a fraction of the listed skills and knowledge at a time. More will come with experience, supplementary training and more demanding projects. The employers' feeling that something is missing comes most likely from a difficulty in recruiting and/or difficulty in moving employees to new tasks of which they do not have previous experience of.

3.3 Required Developments in Engineering Education

The Report concluded several points that are directly applicable to civil engineering education at universities. According to them, the studies should (more than now)

- be based on projects
- introduce typical project tools, starting from team work
- be closely knit to business by using visiting lecturers, especially in applied courses
- make sure that the visitors' input is applied also to the university's body of knowledge
- co-operate with other local educational institutions, both vocational and polytechnics
- consciously differentiate the university students' skills profiles from other institutions.

To ensure the future success of the construction and real estate sector, it was considered necessary to ensure enough resources for the university education in these fields. By now the resources even for basic teaching tasks were seen as worrisomely low. The universities were also expected to differentiate themselves from each other by directing teaching and research towards industry's and research and other educational institutions' local focus areas.

In addition to the two major viewpoints of today's civil engineering education – one for design and the other for construction – it was considered necessary to introduce a third approach. It should concentrate on customer needs and service businesses over the entire life cycle of the built environment.

The Bachelor degree caused some concern among employers. The degree was introduced to the Finnish higher education as a result of the Bologna process, having previously been at use only in the Polytechnics. The employers expected that close to no university student would skip the Masters part of their studies, as the first part is seen as theoretical and as one that does not provide real tools for working life. Same can be put more straightforward: Bachelors from Polytechnics are considered as readily productive, Bachelors from universities as raw material that cannot be used as such.

It was noted that not even a graduate with a Masters degree is productive from day one. This was not considered as a handicap, if the resulting graduate has the versatility, ability and will to learn and develop. Strong background on natural and applied sciences is necessary, but the true value of a university graduate is realized only when the technical knowledge is combined with administratively, financially and socially demanding projects and situations. To develop students towards this, the university should encourage students to interdisciplinary major-minor combinations. This should be done also by attracting students from other fields to choose their minor subject from construction and real estate.

3.4 Future Training Needs

All directors interviewed for the Report admitted that no clear set of skills and data will be enough for any graduate for his or her entire working life. The needs are changing at rapid pace at all levels of business, society and the environment. Thus it will be necessary to learn, apply and also forget new and old truths throughout anybody's career. Training for this cannot be only the responsibility of the universities.

For updating the knowledge and skills of their personnel, all of the big companies had established programs for knowledge dissemination and training. At its simplest this meant short in-house info events once a week on acute matters. At the other end are the outsourced training packages comparable to 20-40 % of an MBA. Part of the outsourcing is bought from the universities, notably from their centers for extension studies.

3.5 Impact of the Current Recession

Current downturn has cut construction site starts by 30-60 % (depending on the construction subsector) from previous year. The percentages are somewhat misleading, as 2008 saw the end of boom that has been accumulating since the last recession. The government has also been rapidly responsive to the demands of the industry and large recovery measures have been activated to avoid large-scale collapse. Out of the total work force of 190.000 employees, about 40.000-60.000 have been estimated to be unemployed still by the end of 2009. The structural base load is 15.000 unemployed even at the best of times.

For civil engineers, the outlook is still far from catastrophic. The total unemployment rate is about 2 per cent, which can be considered almost as full employment. The relative number of unemployed or laid off individuals has anyhow grown remarkably during 2009, being 230 persons by the end of July. As also construction sites are becoming completed by the end of year and large part of design work for close future is already done, the situation is still likely to get worse. It might take years for this development to change direction back to positive.

3.6 Research Work in Collaboration with Industry

At Helsinki University of Technology, 42 percent of the total funding comes from outside the University. Of this, roughly one half originates at the industry directly. Another half comes through the Finnish Funding Agency for Technology and Innovation, and the Academy of Finland**.** The funding is compiled from various research projects, which are supporting the final PhD- and MSc-theses. The topics for these projects originate often at the problems met in the industry. To some extent, the industry is supporting the basic research in addition.

4 National Report for Germany

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4.1 The Bachelor Gets Going in Civil Engineering

Following the introduction of the Bologna Process a complex discussion on structural changes in the German system of university education is currently being held in the field of synergies between the academic and professional worlds in Germany. This new situation is controversially discussed especially at the universities, but also in the building industry. In 2010 all the Diploma Study programs should be replaced by the Bachelor and Master programs. But according to an actual survey with 5,000 personnel experts showed considerable reservation concerning the qualification of the latest generation of students in June 2008. Especially aspirants with a Bachelor degree might have problems getting a job. 61,4 percent of the surveyed personnel experts prefer the diploma as the better alternative.

Also the students are in two minds about the Bachelor system – that's the result of the tenth "Studierendensurveys" (Studentssurveys) published by the Ministry of Education. Only 12 percent of the surveyed students assume good job chances having a Bachelor degree. In 2001 this number was about 25 percent. 44 percent advance the view, that the Bachelor system limits the individual study arrangements. The exact opposite was the main aim of the Bologna reforms. 52 percent do expect that the Bachelor is developing to a graduate of second class. Especially students of the engineering sciences threat the Bachelor system with reserve. Meanwhile the German Hochschullehrerverband (Association of University Professors) is speaking about a red alert concerning the Bologna reforms. A few employers are trying to reraise these fears. Therefore 38 companies gave new impulses to the initiative "Bachelor Welcome" during the 30th June 2008 in Berlin. In order to understand better, why the discussion is so controversial it is worth to have a look briefly at the traditional engineering education and at the current situation in the construction industry in Germany.

There are in principle two systems of German engineering education, the Fachhochschule (FH) and the Technische Hochschule or Technische Universität (TH/TU). According to the constitution of the Federal Republic of Germany, education is the responsibility of the federal states. The federation only controls the general principles of the higher education system which are set in the Federal Higher Education Framework Act.

"The higher education system promotes and develops science and art through research, education and studies. The institutes of higher education prepare (students) for professional activities which require the application of scientific know-how and methods… . The different types of schools contribute to this aim according to their specific tasks. Universities link education and research in order to provide a primarily scientific education. ... Fachhochschulen offer application-oriented education which enables students to make use of scientific methods in professional practice. Fachhochschulen may pursue applied research and development projects which support their educational tasks in so far as they are financed by third party funding. (Article 2)"

German engineering education normally does not have a tutorial system or fixed learning groups. Students are expected to initiate their own study teams. It is a system in which the student acts primarily as an autodidact drawing educational benefits from the system according to his or her own estimation and decision with a certain amount of orientation naturally being given by assistant staff and fellow students. However, the system does not actively "form" the student as is the aim of the French system of formation. Students become formed by succeeding in the system, open and liberal as it is.

While attendance of lectures and tutorials is in general not compulsory, examination prerequisites in the form of calculations, design work and lab reports are controlled thoroughly and the examination themselves are subject to strict organization and high standards. Although there is now a tendency to prescribe a more strict schedule in particular for the basic study phase, German engineering students are not usually obliged to sit an exam immediately after the semester in which they attended the particular course.

The typical engineering professor at a university works at a considerable distance from the students. His or her function is to run a unit (Lehrstuhl, Institut) which is engaged at once in research and in education. The professor is responsible for the management and maintenance of this unit, the development of research projects and for raising sufficient funding. During the lecture period (there are two per academic year, each of 15 weeks) he or she gives 8 lecture hours (each of 45 minutes) per week and is active in academic coordination and self-administration. In the lecture-free period he or she has to organize and supervise the examinations. It is mainly the advanced and postgraduate students who pursue project work in a research unit or are employed in a research team who have the opportunity to learn through personal interaction with the engineering professor.

The situation is, to some extent, different at the Fachhochschule: the FH-professor gives 18 lecture hours per week, the FH-lecture period comprises 9 weeks more than that at the university and the schools and their sub-units are smaller. Research activities play a minor role. The professor at the Fachhochschule therefore has more contact with his or her students. This situation is, however, affected by a surplus of students and a shortage of teaching staff.

It is primarily the level of mathematical instruction and the extent to which subjects such as physics and mechanics are based upon advanced mathematical methods which make the actual difference between the education provided at the Fachhochschule and the Technische Universität. Both institutions stress their practice-oriented approach, their point of reference obviously differs: the FH refers to the professional practice of engineers, the TH/TU to the practice of advanced R & D.

The position of both institutions in relation to each other is a permanent subject of reflection and discussion in Germany.

The Fachhochschulen have far fewer assistant scientific staff as well as less equipment, and funding and therefore do not have the capacity to pursue basic research and complex R & D projects. The education provided by the FH is thus not designed to promote a particular research ability among the engineering students.

Due to the uncertainties of the economic development in Germany, and in Europe as a whole, it is not possible to forecast the demand for engineers more precisely. The interest of school-leavers in engineering studies obviously reflects the movements in the labour market. Placement problems usually reduce the number of new students, which leads to a shortage of engineers after one cycle of studies.

The number of newcomers in the civil engineering in Germany has during the years vigorously declined. In 2001 the number of newcomers has stabilized, but on a very low level! The information is for the whole building industry alerting. Since 1997/1998 the number of newcomers in all kinds of universities declined at 40 %. It is especially dramatic in technical universities, where future managers are educated. This group of beginners has declined at almost 60 % in whole Germany in the considered period of time.

The major reason for the loss of applicants for a place at the universities are mostly negative headlines about the decline of building activity or the spectacular failures, but not the number of unemployed engineers. It is true, that the building branch has to put up with the reduction of investments. But that fact could not really surprise, because the reintegration of East Germany caused an unusual building boom, which had to fade away inevitably. The negative development, which was purely a German problem – in Europa and the whole world the figures are quite different – is in the meantime to the greatest possible extent abated.

The fact remains, that each 12th employee in Germany is directly or indirectly engaged in the building branch. The building industry remains a key national industry. With a 14 % share in the gross domestic product it is one of the most important branches of industry in Germany. However the building branch is at structural change, which demands a unanimous notion of all engineering experts and especially long-termed highly qualified personnel, it means civil engineers, who graduate from universities.

4.2 Quality and Quantity should be Proportional

From point of view of the Civil Engineer the question of the quality of education needs to be answered as urgently as the question of quantity of the young academics. The latest release of statistics concerning the number of civil engineering students from ~~of~~ the Hauptverband der Deutschen Bauindustrie (Association of German construction industry) shows more Bachelor and Master students than diploma students for the first time. In the summer term 2007 and in the winter term 2007/2008 4676 freshman students enrolled to the Bachelor systems (3150 at Fachhochschulen, 1526 at universities) but only 1326 matriculated to the diploma system. That means 78 percent of freshman students prefer~~s~~ the Bachelor system. The total number of the first term-students in civil engineering decreased to 6.002, which means 0.8 percent less when compared to the lowest level of 2006.

5 National Report for Greece

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In this brief report on the theme of developing synergies between the academic and professional worlds in Greece, with specific reference to civil engineering, an attempt is being made to address all critical factors that affect this crucial issue for the country's economic development. To this end an integrated approach is employed in order to identify the impacts of various agents from both the educational and labour market systems, as well as to highlight the most significant relationships between them. Within this framework, the rest of the report is structured in five distinct sections, plus a Bibliography one. The five main sections deal with: a) the demand and supply status in formal and continuing education of civil engineers, b) a review of past and present employment practices, including recent trends in career decisions of young professionals, c) the particularities and especially the mismatches between higher education and the labour market, d) the changes and developments needed in restructuring university curricula, and e) a preliminary examination of the related impacts on the profession of the current worldwide economic crisis.

The views and information presented in this report are mainly based on findings and relevant discussions obtained from various texts, such as newspaper, magazine and journal articles, institutional reports and meetings summaries, the most important of which are cited in the "Bibliography" section. A significant part of this written evidence draws conclusions from surveys that have been recently conducted using samples from different, yet related populations, among which engineering professionals, graduates and prospective students consist the dominant groups of respondents.

5.1 Formal Higher Education and Continuing Professional Development

Entrance to higher education in Greece is attainable for students who have attended lyceums, i.e. those who have already received 12 years of formal education. This continuation of studies requires the successful participation in general nation-wide examinations, a system based entirely and exclusively on the high school curriculum. Students declare their preferences for institutions and further on for specific schools/departments after an initial selection of the major fields of study, each of which comprises a specified set of institutions. civil engineering studies are offered by five universities (with courses running for ten semesters) and a few technological institutions (with courses running for seven to eight semesters).

Under the described system of examinations, access to higher education in Greece is highly competitive, at least for some disciplines (e.g. medicine, law, engineering etc.), of which the number of available university places is not sufficient to meet the extremely high demand. This condition is driven by the conception of Greek students and their parents that university education offers increased opportunities for a good job, and thus for greater economic benefits, a steady career development and, last but not least, an upward social mobility. This is why, of those who are not successful in entering a national university, a large number of them opts for enrollment in university studies abroad, instead of continuing their studies in technological or vocational training institutions at home.

Civil engineering stands among the first preferences of candidate students in the general group of major fields that comprises all branches of engineering, the natural sciences, information and computer technologies and so forth. During recent years, more than 60% of successful entrants in the country's civil engineering departments have declared this discipline as their first-choice one, while more than 90% of them have included it in their 1-3 most preferable disciplines. Given the relatively high number of places offered in all civil engineering departments, the annual total output of domestic graduates fluctuates around 1,000, to who another 200-250 are added from those immigrating after completion of similar studies abroad. Before entering the labour market, about 40% of all these graduates continue for postgraduate studies, either at home (55%) or abroad (45%).

Although quite respected and fairly-high demanded by young professionals, continuing professional development is not widespread in Greece. Unfortunately, universities have not yet been involved in this kind of activities, leaving thus space mainly to the Technical Chamber of Greece, which represents all registered professional engineers in the country and acts as an advisory body to the government. In fact the Technical Chamber operates quite successfully a relevant service, by offering short courses and seminars on a wide range of subjects to its members.

5.2 Employment Status and Career Decisions

Civil engineers used to be among the most active and prosperous professionals in the country, first of all during the three decades following the second world war, when they undertook a major role in the nation's big reconstruction enterprise. Most of the profession's long-lasting nationwide popularity owes a lot to that particular "golden age" of the construction industry. In the following period (i.e. from late 1970's to late 1980's) the construction rate of public infrastructure declined. Yet, practicing civil engineers continued to be quite busy working either as self-employed individuals or engaged in numerous small-to-medium size engineering firms, mainly supported by private sector funds invested in housing, real estate enterprises and other projects (e.g. for the development of many tourist regions).

The principal characteristic of the period up to the 1980's is that the number of civil engineers working in Greece was at maximum only half of the totally employed ones during the 1990's and almost a quarter of today's workforce. Thus, the apparent prosperity of those professionals was due also to their high personal share in the construction business. This share became much lower during the next years, as a result of a rapidly increasing rate in the number of young civil engineers entering the profession, the main driving forces for this being: (a) the quite attractive, still fictitious, picture of an occupation that seemed to secure economic benefits, and (b) the beginning of the massification in higher education, which quite shortly doubled the output of graduating engineers.

The current workforce of civil engineers in Greece amounts about 24,000 university graduates, a significant percentage in regard to the country's population and substantially above the EU average. Overall unemployment averages 2-3%, but a steep upward trend at almost two-digit figures holds exclusively for the new generation of civil engineers. In addition, there is notable evidence that, mainly in the private sector, unemployment rates of engineers may vary depending on the institutions from which they graduated. Still, these figures are relatively low when compared to those concerning lots of university-degree holders from other disciplines. Misemployment rests also at non-alarming levels, far below the national average for educated professionals.

What, indeed has changed today, as compared to the recent past, is the type of employment. A second period of blooming of the construction industry, that initiated in mid 1990's and lasted up to 2004, when the Olympic Games took place in Athens, was marked by high investments, particularly by European Community Frameworks' and national funds, in the construction of several major public works, some of which reshaped in a very positive way the transport infrastructure and services, mainly in the area of the country's capital. The already expanding at that time big consulting and construction firms – to the detriment of many small-to-medium size ones, of which the net creation of new firms started to decrease constantly – profited more, by not only undertaking huge projects at home but also by extending their business in the neighboring Balkan countries. These big enterprises moved young engineers away from traditional self-employment to non-permanent job engagements in the big firms. Unfortunately, this very productive period did not last for long. To the worse, it was almost immediately followed by a rising recession that lasted up to our days when the global financial crisis multiplied the existing negative impacts.

As a consequence, in today's real world career planning of new civil engineers is mostly affected by sound insecurities as to the future prospects of a profession that does not seem any more to be a lucrative one. Thus, in relation with the first professional engagement a rather typical decision path is being followed. Data from recent surveys show that the majority of fresh graduates opt for a permanent employment in the public sector or, if this is not possible, for a part-time contracted one to it. As the number of relevant available places is not abundant, from those who do not succeed some try self-employment risking thus serious intermittent periods of professional inactivity, while the rest settle for various types of jobs offered by an unstable private sector, at the cost of low remuneration, sometimes even less than of the already low-paid public sector.

5.3 Mismatches between Higher Education and the Labour Market

Although recent Civil Engineering graduates are in general not dissatisfied in making their way through the labour market, a more careful insight into their professional status and rewards provides some additional points for a further discussion. The present discussion is confined to existing mismatches between the education, which has already received any individual entrant to the labour market, and the qualifications associated with the particular occupation, for which he is applying. The most apparent occupational mismatches in relation to Greek university-degree holders, apart from their oversupply mentioned previously, include excessive schooling duration (and, consequently, excessive acquired degrees), a redundant theoretical-academic background and a shortage of skills specifically required by the private sector.

First of all, the phenomenon of overeducation dominates all over Greece. As mentioned before, the number of those who proceed with a further upgrading of their formal qualifications (i.e. for postgraduate degrees) is significant. Such a trend is justifiable only in part, and more specifically by the tough competition among an increasing population of graduates who apply for employment in the, more or less decreasing in size, public sector. As a result, the hiring policies of the public sector favor the recruitment of university graduates. Still, it can be easily substantiated that the majority of public servants are overqualified for the service they provide, or, in other words, that all these workers' educational capacities and skills are underutilised. Monetary rewards are also low when associated with education, especially at the higher levels. On the other hand, the private sector in average does not appreciate much extra qualifications, like master's or higher degrees, with the exception of some specialisations, which, depending on the case, can be considered useful. Normally, an undergraduate degree is considered adequate for the employment of young graduates in small engineering firms, as their leading preference for them is to have enough working experience in order to be immediately productive.

As far as the knowledge and skills acquired during their rather long period of university studies is concerned, young Greek employees of the public sector and, even more, of the private one admit that they substantially oriented towards a solid traditional model of civil engineering education. Such schooling, albeit it provides students with a probably more than adequate theoretical knowledge and sufficient technical skills, it lacks some specific elements that are of high value within various job environments. And, above all, this mono-disciplinary education shapes a classic engineer profile, which is, more or less, out-of-date, considering the complexities and uncertainties of modern techno-economic systems. Of course, discrepancies between contents of studies and employment vary, depending not on the type of occupation alone but on the diversities of academic curricula offered by different institutions. Still, practically all Greek university syllabi are to some degree inadequate, concerning the provision of certain specific knowledge topics and skills, and they therefore need to change, somehow as presented in the following section.

5.4 Required Changes and Developments in Education

Education and the professional practice of engineers are linked to economy and the labour market at a degree that depends on both the structure and dynamic development of the economy and the timely adaptation of university curricula. However, this arduous relationship should be as tide as possible at any time. To this aim, civil engineering studies should provide: (a) a sound scientific-theoretical background, (b) a related to the discipline at hand technical knowledge, (c) knowledge and practice on ICT applications, (d) a basic inter-disciplinary background on topics useful in the current professional activities, and (e) the training for the development of specific skills, especially non-technical ones, also dictated by the labour market needs.

Surveys administered to new employees and their employers show that the last three items of the above list need, at varying degrees, a proper enhancement. Most respondents suggest the introduction of new or the improvement of existing courses and training modules in the topics of law, economics and management. Such a curriculum development could benefit not only the graduates who will choose to be employees but also those who would select self-employment. As already mentioned, the great many self-employed civil engineers in Greece, who used to be quite useful to the country's economy, are lately declining in number, particularly because of the reluctance of younger professionals to initiate such an occupation under the current difficult and unsafe conditions. To a certain degree, the hesitation to establish their own small firms is attributed to the lack of sufficient entrepreneurial capabilities. Therefore, the provision of additional education and training in the three specific topics above would much probably result to more self-confident and self-efficient prospective young entrepreneurs.

Additional suggestions, declared both in surveys and expert meetings, for further educational changes and curriculum development include: (a) an interdisciplinary learning about a wide spectrum of environment and energy issues and (b) general training modules in information and computer technologies plus a selection of specialised computer applications (for all sub-disciplines of civil engineering), which are used by the practicing professional world.

5.5 Impact of the Current Recession

It is beyond any reasonable doubt that the current world economic downturn will seriously affect the industry, but, to some degree, the academe as well. Early signs of its harmful impacts relate to numerous Greek enterprises, among which quite many from to the construction sector. Not only the public sector has reduced existing and planned funding in infrastructure projects but also the private sector seems quite helpless in risking new investments, as they already massively report declining turnovers. As civil engineering professional are predominantly involved in traditional construction and building activities, yet much less in RD ones, it is probable that the crisis might generate a positive opportunity for a shift in other new developments and technologies, which, after all, would benefit the country's development.

However, up to the time that the whole system will be reorganised and conformed to the new reality, the difficulties of young engineers in finding the employment of their choice are not likely to improve at all. Apart from this immediate consequence to the current workforce, such an ominous prospect could adversely affect the above described traditional high demand for civil engineering studies, at least from among the most qualified graduates of lyceums.

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6 National Report for Italy

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In order to accomplish such a task the documents listed in the reference list have been consulted. The papers produced by the "Consiglio Nazionale degli Ingegneri" concern the Italian labour market for Engineers. The paper of the Consortium Almalaurea concerns the actual and potential occupation of graduates in Italy. The present economical crisis and its effects in the near future are also considered in this last document.

6.1 The Italian Labour Market for Engineers

As a general premise (see Table 1) it is relevant to stress that Italy invests a very small percentages of the GNP for Higher Education and Research. In addition the number of graduates over 100 people with an age in between 25-34 years is very small compared to other countries.

Table 1. Resources invested in different countries for higher education/research and number of graduates (Almalaurea)

Country	% of GNP spent for Education	% of graduates (*)
Italy	0.78	17
Scandinavian	2.00	NA
Germany	1.16	22
USA	1.32	39
France	1.21	41
UK	1.02	37
Japan	NA	54

(*) Number of graduates over the population with an age between 25-34 years.

The total number of engineers (in Italy) in 2006 was 478000. In the following the main statistics, concerning the population of Italian engineers, are summarised (year 2006).

Employed: 371.000 Unemployed (looking for a job): 15000
Men: 401000 (80% employed) Women: 77000 (70% employed)

Employed in companies and Public administration: 70%
Employed as practising engineers: 30%
Net monthly salary after one year: 1041 euros (1st level degree)
Net monthly salary after one year: 1230 euros (Master degree)
Net monthly salary after 5 years: 1630 euros (Master degree)
Net monthly salary of women is 14% less than that of men.

One year after graduation a quite large percentage of graduates is employed (76.1% in 2006). A percentage of 43.8% has a permanent position, whilst 43.5 % has a temporary contract. The percentage of temporary contracts increases to 53% in the case of women. It is worthwhile to remark that there is a trend for women with children to leave the labour market or to accept part-time job.

Most of the graduates (97%) is employed three and five years after graduation. A quite large percentage (about 70 % from 2000 to 2007) has a permanent position without any difference among men and women. It is worthwhile to remark that for civil and environmental engineers the percentage of permanent positions (year 2007) is only 55%.

Generally, the time required to find the first employment is three months.

It is possible to draw a first conclusion: Italian Engineers easily and quickly find a job which is not well remunerated.

In 2006 the labour market has requested 19000 new engineers (practising engineers, companies, public administration) in front of 24000 new graduates in Engineering. Anyway, since 2006 the number of new positions offered by the Public administration started to decrease: only 436 new positions against 900 new positions in 2005. In 2007 while the request of Engineers was more or less stable (-0.2%), that of Civil Engineers sharply decreased of about 12% because of the Italian crisis of the construction sector.

It is worthwhile to remember that Almalaurea database contains 1.200.000 curricula of new engineers. To have an idea of the impact of the actual economical crisis, it is interesting to remark that in the first bimester of 2009 the request of curricula from the Almalaurea database had a reduction of 23%.

More generally, the Italian labour market consists of small and very small companies. Such a type of companies has tremendous difficulties to support the cost of very qualified engineers and to compete at an international level.

The situation is even worse for civil engineers. It is worthwhile to remember that, as far as the Engineering Services are concerned, different competitors are present in the market. More specifically:

- technical staff of Public Administration or Public Bodies;
- engineering societies

- individual practising engineers
- international operators.

Statistics referred to year 2000 indicated that totally there were 77000 practising engineers, societies with more than 6 employed people were less than 650 whilst 13000 societies had between 2 and 5 employed people. Individual practising engineers had more than 40% of the market whilst the technical staff of PA and Engineering Societies (more than 6 employed people) had about 30% each.

In addition, referring to the same statistics of year 2000, 81% of practising civil engineers had their activity within the residential district, another 14% had their activity within the residential region. Only 5% had activities over the Italian territory and less than 0.8% outside Italy.

Eventually 90% of the job was obtained without participating to any public competition.

As a second conclusion, it is possible to state that the Italian labour market for engineers (especially civil engineers) is not competitive, nonetheless it consists of many individual subjects.

6.2 Basic Requirements for Industry

Companies, employing engineers, essentially ask for the following requirements:

- previous experience in the same job or at least in the same type of economic activity (65.5%);
- robust knowledge of computer science (99.4%);
- knowledge of a foreign language at least (73.2%);
- courses organised by the companies for engineer-training.

On the other hand, post-graduate courses of specialization (i.e. masters, doctorates, etc.) are required, on average, only in very few cases (9%).

Table 2 summarizes the basic requirements for different type of Engineers as emerged from statistics elaborated in 2007. In addition to the information reported in table 1, it is worthwhile to point out that the knowledge of “Computer Science” (as users or as experts) is required, for any type of Engineering, in more than 99% of cases.

It is also important to point out that the percentage of Civil Engineers that are employed as manager is lower in comparison to other types of Engineers.

Table 2. Requirements from Companies

Engineering	(1) %	(2) %	(3) %	(4) %
Civil & Environmental	13.2	30.9	62.9	45.0
Electronic and Computer Science	8.3	49.6	67.2	77.3
Industrial	7.3	49.5	65.0	76.0
Others	10.5	42.2	62.2	67.5

(1) Post-graduate courses
(2) Training organised by the companies
(3) Previous experience
(4) Knowledge of foreign languages

6.3 University Outcome

As a general premise it is worthwhile to stress than since 2002 the number of pupils entering University Studies has continuously decreasing from about 75% to 69%. Anyway, the number of students of Engineering Faculties is more or less stable in the last ten years. Yearly, about 35000 new students are enrolled by the Engineering Faculties.

Statistics provide by Almalaurea indicated that graduates in civil and environmental engineering (2008 – first level degree – 2300 answers) graduated after an average period of about 5 years at an average age of 24.5 years. A large percentage of those graduates entered the second (Master) level (85%). A very small percentage of those graduates attended a (post-graduation) practical placement or stage or training course in the Industry (totally 15%). About 44% of those graduates became employed after graduation but only 70% of those employed declared their own graduation useful for their job. The same statistics by Almalaurea (2008 – second level degree -374 answers) indicated that the Master degree in Civil and Environmental Engineering was obtained after an average duration of about 2.5 years at an average age of about 26 years. A quite large percentage of those Master graduates has attended post-graduation courses (9% practical placements in Industries; 11 % doctorate; 17% stages in Industries; 11% others). As already indicated, a very large percentage of graduates is employed few months after graduation and for Master graduates only 5% declared that that their own graduation was not useful for their job.

In conclusion, the student career is slow and does not have too many contacts with the professional world, especially as far as the first level degree is concerned. Student qualification, which in general is quite good, is not recognized and appreciated by the labour market. More specifically, even though a quite large percentage enters doctoral studies, the labour market completely ignores this type of qualification.

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7. National Report for Poland

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It is typical and natural for Poland that most of the university staff is working in the industry. Why? There are three reasons: money, money and ... money. It means that there are the same actors (and a couple of actresses) playing roles in the theatre of professional world and in the theatre of academic world. It is good and bad together. Good because the academic teachers have a professional experience and can include practical aspects into teaching. Bad because theoretical subjects (mathematics, physics, mechanics, computational methods, etc.) are usually separated from more practical subjects – and the theoretical base of the teaching is increasing.

There are three "legs" of developing synergies between the academic and professional worlds in Poland:

- Committee of Civil Engineering and Hydroengineering of Polish Academy of Sciences,
- Polish Chamber of Civil Engineers,
- Polish Union of Civil Engineers and Technicians.

Unfortunately the three "legs" are not equal, so there are no correct synergy between the two worlds. Let me show this idea on the picture below.

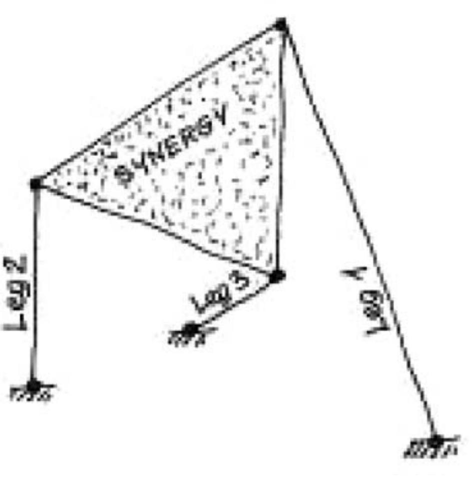

Figure 1. Sloping plane of the synergy between the academic and professional worlds.

It is difficult to say which "leg" is the most important. From the academic point of view the Leg 1 (the longest) should be ordered to the Committee, Leg 2 to the Chamber and Leg 3 (the shortest) to the Union. But, the point of view depends on the point of observation, so, we can ask professional engineers to look for a different classification.

7.1 Committee of Civil Engineering and Geoengineering of Polish Academy of Sciences www.english.pan.pl

The Committee of Civil Engineering and Geoengineering is placed in the Division IV – Technical Sciences – of Polish Academy of Sciences.

There are 26 members of the Committee, most of them from universities or scientific institutes, but some of them are from “professional world”.
There are the following sections in the Committee:

- Concrete Structures,
- Mechanics of Structures and Materials,
- Management in CE,
- Hydroengineering,
- Geotechnics and Underground Infrastructure,
- Building Materials and Building Physics,
- Metal and Timber Structures,
- Engineering Communication,

with more than 200 scientists and practicing engineers working together in the field of:

- Examination of building structures during design, building and exploitation,
- Modernization and reparation of the structures,
- Loads acting on the structures,
- Interaction of the structure and foundation,
- Building materials,
- Environmental engineering,
- Hydrotechnical structures,
- Roads and bridges,
- Management.

7.3 Polish Chamber of Civil Engineers www.piib.org.pl

The Polish Chamber of Civil Engineers is a trade self-government, next to legislative institutions, regulative structures, economy and business, constitutes an important pillar of the State of law. The activity of the trade self-government of civil engineers is regulated by the following provisions:

- The Building Law Act and acts on trade self-governments of architects, civil engineers and town planners,
- Ministerial regulations: on independent technical functions in the building industry,
- Internal resolutions: the statutes and rules and regulations of the chamber.

The Chamber groups over one hundred thousand engineers and technicians with building qualifications in the following specialities: architecture, construction and building, roads, bridges, demolition, railway, telecommunication, installations of heating, ventilation, gas, water, electrical and power systems and devices.

The Chamber membership is compulsory and only those entered into the list of its members are entitled to perform independent functions in the building industry.

The tasks of the trade self-government include, in particular:

- Exercising supervision over diligent and scrupulous performance of the profession by members of chambers,
- Representation and protection of professional interests of its members,
- Establishing the rules of the ethics of the profession and supervision over the observance thereof,
- Granting and refusing/taking away building qualifications in particular specialities and conferring the title of building expert/surveyor,
- Recognition of professional qualifications of foreigners,
- Cooperation with local government administration and local government bodies, as well as with other trade self-governments and associations,
- Providing opinion on minimum program requirements in respect to the professional education of civil engineers as well as making proposals regarding these issues,
- Trade self-government’s assets and business management,
- Providing opinion on draft normative acts regarding the building industry,
- Conducting proceedings regarding the professional and disciplinary liability of members of trade self-governments,
- Organization and administration of mutual aid institutions and other forms of material assistance to members of trade self-governments,
- Keeping the lists of members of trade self-governments.

7.4 Polish Union of Civil Engineers and Technicians www.zgpzitb.org.pl

The Polish Union of Civil Engineers and Technicians is a self-governments association on the scientific and practical profile. They have 30 branches in Polish towns with thousands of members from scientists, via engineers to technicians working the field of civil engineering.

The main tasks of the Union are:

- Training of civil engineers and technicians,
- Organizing the conferences,
- Organizing and sponsoring the competitions,
- Publishing the newspapers in the field of civil engineering,
- Recommendations for building industry companies,
- Providing opinion on the building

8. National Report for Portugal

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8.1 Skills Shortages

Portugal is presently facing a large internationalization within the construction industry, with companies working in East Europe, Northern Africa, Angola and Mozambique and South America. This allowed for a high level of employment for Portuguese engineers, namely in construction activities and working abroad. Design offices are also with work as they are working for the construction companies working abroad.

Civil engineers in Portugal have a broad education, so they can easily adapt to any job from design, to construction management, as soon as they face the working world.

Presently we have only a slight excess of civil engineers, has we have some unemployment for young engineers namely coming from lower rate universities.

In the next years, with the public works planned by the government to face the economic crisis (6 hospitals, 1000 km of highways, 9 dams and 700km of TGV lines) it is expected to have again a shortage of civil engineers.

In Portugal we do not face lack of candidates for civil engineering. In fact almost all our courses in public universities (7 universities plus several polytechnic at an average of 100 students) reach each year their clausus number for admissions.

Civil engineering is considered by the public as a quality profession, as we have been able to perform with quality several major public works in Portugal and abroad. Our associations try also to promote our profession (not as much as we should do). As an example with have a week TV program describing major construction works.

Skills Shortages:	presently a slight unemployment, some shortage envisaged in near future
Skills Gaps:	not significant due to the broad university education

8.2 The Skills Pipeline

In Portugal this type of problem is not significant as we have a broad education for civil engineers. In the 5th year students may choose a profile (among structures, construction, hydraulics, geotechnics and urban planning) but this means that only 4 disciplines (in the total graduation) may be different among them.

With this schema all our students have a basic formation that allows them to perform any act of civil engineer and their specialization will come with professional life.

This type of education was maintained, even with Bologna, as it corresponds to the industry desire and it agrees with our professional association.

8.3 Quality and Standards

The quality of the Civil Engineers coming out of the universities is checked by our National Association (Ordem dos Engenheiros) that is entitled to give the title of Engineer with which engineers may be responsible to practise acts of civil engineering.

The Ordem dos Engenheiros performs periodical evaluations of the Civil Engineering Courses at the Universities (accreditation) and if approved, students from those universities may enter directly to the Association. Those that come from non approved universities need to perform an admission examination.

Presently the evaluation of the universities is being done within the European Network EURACE.

Related to Quality in Industry, most of our important construction companies have adopted the Quality ISO Standards. The problems of quality arise in small construction companies (usually up to 10 persons), but there the skills do not come from university.

In Portugal the girl-students in civil engineering are increasing reaching numbers above 30%. It is frequent to find a woman directing a construction site, so we do not consider this a problem.

8.4 The Role of Government

8.4.1. Facing the Construction Industry.

Government is always between two situations: public opinion and public jobs. It is a fact that public opinion (namely intellectuals, environmentalists, etc.) tend to be against public works, defending investments in culture, environment protection, etc.

But governments know that when a crisis arrive (as it is now) the only solution to increase quickly jobs is to implement public works. In fact civil engineering works develop a multitude of jobs (reaching even non skilled workers) and they are the best engine to put economy working again.

Civil engineers have a lack of know-how in defending their image. In fact they should bring much more to the public the advantages of the public works they perform. The importance of the construction companies working abroad in the country exportations is never referred as compared with classical industry. The employment associated with construction industry never is presented, but when a car company employs more 100 persons it appears in TV. We should begin to have classes about the Civil Engineering image.

8.4.2. Putting together Universities and Industry

Government subsidies the universities in Portugal, but imposes low fees for the students up to the master level. This allows the industry to receive cheap (for free) engineers and they do not feel the need to involve with the universities. The only slight exceptions are:

a) Post-grad education – Where industry feels the necessity to achieve specialization in some sectors and comes to the universities to have specialized courses. There are already some University-Industry associations for specialized education in civil engineering.
b) Research – Here construction industry is not prepared to make significant investments in research. Usually they perform their own developments and they consider research a cost and not an investment. This leads to some difficulties to have PhD Students in this area as they are not recognized by the industry and their employment is usually related to Research Centres or Universities. Usually there are Government PhD scholarships, but few students candidates.
c) Recently Government imposed to companies winning public works an investment on research of 0,5% of the contract value. It is a good idea if companies decide to invest that amount in research with universities.

8.5 Impact of the Current Recession

The Government has a vast plan for public works (6 hospitals, 1000 km of highways, 9 dams and 700km of TGV lines), most of them in Concession schema.

This is the classical solution to create jobs and put the machine working again. It must be said that to create jobs building construction is better than other public works. Typically in building construction the salaries cost around 30% of the total amount and in roads, TGV, etc, that number reduces due to the increase in cost of machines.

In parallel the investment in universities was reduced around 11% what leads to management difficulties. Public universities begin to feel that they need to adopt a privatized policy to keep their quality levels.

9. National Report for Turkey

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This report reflects the personal opinion of the author who has been teaching in one of the leading universities of the country for the last almost forty years. During these years, he has continuously been familiar with various problems of the construction industry through the consulting work he performed. Since he has always taken part in various activities of the Chamber of Civil Engineers, he also had the chance to observe the changes in the civil engineering community and in the civil engineering profession.

9.1 The Current State of Civil Engineering Education

Despite the significant physical and technological improvements introduced, the level of the civil engineering education does not appear to be as high as it used to be a few decades ago. One can easily list some of the major factors causing this change:

- Civil engineering is not as popular as it used to be, most probably due to the less attractive employment conditions. The modest salary for the hard work does not appeal to the younger generation vis-à-vis the attractive income promised by the finance sector. Consequently, the best students do not prefer studying civil engineering.
- A high school graduate is admitted, on the basis of his/her entrance examination score, to a university programme among the 18-20 programmes he/she has indicated in order of preference. Very few students are placed in programmes of their first choice. In other words, majority of the civil engineering students are studying civil engineering, although it is not their favourite subject.
- Numerous universities have been established in the last three decades without preparing the required faculty infrastructure. So, there still are some civil engineering departments striving to train civil engineers without a sufficient number of competent faculty.
- Recent developments in the software industry are misinterpreted by engineers and engineering students. They have the illusion that the blind use of the software available in the market makes them engineers. This is another important factor that makes the students loose their already insufficient motivation and interest.

However, the author is not pessimistic about the above explained level of education. His teaching experience abroad (USA, Canada, New Zealand, UK) gives him the impression that these problems are rather universal.

9.2 The Construction Industry

The construction sector occupies an important place in the Turkish economy. It may presently be somewhat slow due to the global and local economic fluctuations. However, it will no doubt come back and resume its leading part soon. In other words, civil engineering is still a much needed profession due to its great work potential and will remain that way during the next few decades. The industrial and social infrastructure of the country has not been completely constructed yet. Besides, the existing infrastructure is aging and thus is in need of rehabilitation and possible expansion. Another considerable work potential lies in the seismic retrofitting of the existing building stock or its replacement.

As far as the level of civil engineering practice is concerned, construction industry displays a peculiarity and takes place in the two extremes. On the one hand, top quality design and construction services are provided by the leading companies successfully competing all over the world. On the other hand however, a substandard even deficient civil engineering practice is quite widespread. The typical example of the work of the latter category is the huge seismically vulnerable mid-rise building stock resulting from improper design, substandard construction, deficient materials, improper workmanship etc.

The unsatisfactory civil engineering practice mentioned above cannot be directly attributed to the problems of civil engineering education. The contribution of the insufficient and possibly incompetent construction supervision system cannot be ignored. The present construction supervision system seems to require a substantial revision.

9.3 The Need for New Civil Engineers

The present number of civil engineers registered with the Chamber of Civil Engineers is around 70 000, and more than 3 000 new graduates are being added each year. In view of the expectations of the “Five-Year Development Plan” of the State Planning Agency, this is a rather satisfactory picture. However, the author tends to attribute more importance to quality than quantity, thus he is primarily interested in increasing the number of qualified and capable civil engineers. He considers the present number of undereducated, barely standard civil engineers adequate, if not excessive.

The author is convinced that the establishment of a professional engineering system may significantly contribute to the betterment of the civil engineering practice, through social encouragement for the engineers to improve their educational and professional performance level. A good deal of progress has been made in the last three years towards the development of a professional engineering system within the Chamber of Civil Engineers. The system is expected to become operational in Spring 2009.

Continuing education is another important component that may help the improvement of the civil engineering practice. Construction industry does not seem to pay the due attention to continuing education. Few companies care to encourage their employees to take continuing education courses, and even fewer organise such courses themselves. However, to enforce continuing education, the Chamber of Civil Engineers requires a certain number of continuing education credits for renewal of licence. To this end, they organise hundreds of continuing education courses all over the country every year, and issue credits to the attendants. They are presently in the process of improving the contents and standards of these courses.

10. National Report for the United Kingdom

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10.1 Skills Shortages

One of the key issues facing the Industry is a shortage of numbers (NCE 17 Jan 2008). In the UK, the Industry has a great deal of work (Olympics, Crossrail, etc) but is struggling to find staff for all the potential infrastructure projects we need to undertake. The problem is widespread, but particularly notable in ground engineering, which is central to almost all construction and building projects (NCE 27 Nov 2007). Other areas of shortage include project management (ICE State of the Nation Report Jan 08) At present, we are taking workers and engineers from abroad. In the long term, this is neither sustainable nor morally justifiable. We need to expand the intake into university courses, but there is a key problem here, namely preparation in schools.

CIC BEPS Survey 03/04 identifies problems with shortages in management, communications, literacy, problem solving and client handling. On the technical side, IT, agreeing design schemes, design development, procurement strategy and controlling construction operations are shortage issues. However, these are topics which are best learned by gaining experience on the job rather than in formal education. Perhaps the role of Universities here is to create awareness of these topics rather than to teach them in a formal sense.

Somehow, both companies and young professionals, coming up through the University system must become more committed to the Profession. Hence there is a role for both to excite and inspire young people.

Visibility is a problem. Universities and Industry could collaborate much more to influence the general public and young people about the importance of Civil Engineers in providing our living environment

Skills shortages are also problems for some existing staff, raising the whole question of CDP and retraining. The big problem here is companies not having the time to release people and the workload of existing staff going up all the time because of difficulties of recruitment and retention.

10.2 The Skills Pipeline

One of the key problems we face is the level and type of preparation in schools. Getting pupils to make the right subject choices early is essential if we are to have a good supply of students coming forward for University study. This is a big issue in the UK and Industry is trying to increase its influence so that school pupils think about possibilities of working in Civil Engineering at an early age, so that they stand more chance of making the correct choices of subjects to study at school, giving them the correct preparation for entry to University. In the UK, there are also discussions about how to give pupils a second chance if they have not taken the correct school subjects, by having foundation courses and other means of entry. There is also the development of new school programmes in vocationally orientated studies, the aim of which is to give pupils better preparation for entry to engineering and science at University and thence to the workforce. At the time of writing, nobody, including Universities, it too clear how these courses in schools will develop, so it is not yet possible to say if they will be successful in increasing the number of students coming forward.

10.3 Quality and Standards

Many employers say that the general quality of UK graduates available to the Profession is good, though some feel that this is not uniform and that standards are falling in some disciplines (IStructE Dec 07), with particular problems in building services engineering. However, it is clear to all that there are not enough people of sufficient quality, both at Operative and Engineer level. UK Industry currently needs 12000 new recruits per year in Civil Engineering, Architecture and Surveying, and is finding it very difficult to achieve this. Some novel ideas are proposed for tackling this problem:

- Certain sectors, notably girls/women and ethnic minorities are poorly represented in the Profession. Why should this be? If we could interest more of these people we could overcome some of the shortages we face.
- Buddy schemes. Keep on 65 year olds, many of whom wish to continue working, or have to secure their pensions, so buddy them up with the youngsters. They will provide wisdom and the youngsters will provide the effort and enthusiasm.

10.4 The Role of Government

Both Universities and Industry are not helped by the attitude of Government to the Profession. Government is the biggest single commissioner of infrastructure and what Industry needs most of all to deliver Government requirements is a stable planning structure, which will encourage long term investment. Universities increasingly complain about the way that funding for Civil Engineering education has fallen, both for undergraduates, where the unit of resource is below the cost of delivery (RAEng submission to the HoC Education and Skills Committee, Dec 06) and for Masters Programmes where the amount of funding for expert specialisation has also dropped and Industry is increasingly expected to pay for this.

There seems to be an important role for Universities and Industry to work together to persuade Government of the importance of long term investment and planning for the built environment. For example, in recent times, courses have closed; perhaps some should be opened, or existing ones should be given the scope to expand. Perhaps there could be earmarked funding for Civil Engineering, just as there now is for Chemical Engineering and Materials.

10.5 Complementary Roles for Industry and Academe

To a large extent, Industry and Academe both know what needs to be done and by working together with Government and Professional Bodies, can achieve change. The first point is to allow for students to continue to receive a sound theoretical training, but to be able to apply it to the solution of real, practical engineering problems. This will require closer collaboration between the two sectors, for example, by course content reflecting better the needs of industry and for industry to provide more opportunities for students to gain practical experience. The second overcome the problem of stagnation of output, by training more people to cater for the skills shortage. The third is to train the New Engineer to deal with current and future problems. There is a view that courses have not changed in a significant way for many years and that they need to do so in order to be able to produce graduates who can understand and service Industry’s current and future requirements. The key issue is for Universities to offer courses which inspire and motivate graduates and produce a strong supply of them, equipped with the understanding, attitudes and abilities necessary to apply their skills in the industrial and business environment. This means graduates well prepared in two broad areas: technical skills, including disciplinary fundamentals, mathematics, creativity and innovation, along with the ability to apply these in practice; and enabling skills, such as communication, teamworking, and business awareness of the implication of engineering decisions and investments.

A number of steps need to be taken to achieve these aims. These include:

- Getting things right in schools, by enhancing the understanding of what engineers do and why this is important, and by preparing pupils properly in mathematics and physical sciences. There is an important role for Industrialists here, as well as for school teachers
- Getting the approach right in Government, by the provision of adequate funding for university engineering courses and a stable planning framework for infrastructure investment and development.
- Getting the accreditation process to act as a driver for change rather than simply as an audit of quality
- Getting more industrial input into undergraduate programmes, via more industrially relevant projects, visiting lecturers, industrial placements and case studies
- Making undergraduate courses more inspirational, so that graduates are encouraged to remain in the sector

- Re-addressing the balance between research and teaching in universities to ensure that while research excellence is maintained, the importance of teaching is not neglected.
- Recognising the importance of specialist postgraduate training for Industry, including both Masters and PhD programmes
- Enhance and re-structure continuing professional development more towards the needs of Industry, and make it easier for people to retrain
- Attract Engineers from a wider cross-section of the population, many sectors of which, such as girls/women and ethnic minorities are currently very under-represented
- Retaining staff already in the Industry, by maintaining and improving salaries and conditions. Over the years, too many good people have left because of disillusionment and poor salaries.

Another way of looking at this is to consider Engineers as operating in three difference spheres:

- The Engineer as Specialist: deals with technical issues
- The Engineer as Integrator: operates across boundaries in a complex business environment
- The Engineer as Change Agent: focuses on innovation, creativity and leadership

It is also important for Industry to value its staff, especially the unsung heroes, including the technical staff who undertake some of the less glamorous but incredibly vital tasks such as designing water treatment plants and maintain the underground (NCE Jan 2007)

10.6 Impact of the Current Recession

This is necessarily a short and brief note at this stage, January 2009, but the interaction between Industry and Academe will be greatly affected by the current world economic downturn. It is perhaps too early to say how things will work out, but the following are likely:

- Jobs are likely to be hit hard, so there will be increased unemployment in the Construction and Building Sectors
- This may have an impact on how young people perceive Civil Engineering as a career and therefore whether they are likely to apply for places at university. However, the economic crisis covers many sectors, not Civil Engineering alone
- Some staff who are made redundant may take the opportunity to re-train and re-specialise, which could lead to a boost for university entrance

- Governments are likely to make cuts in education budgets, which may well affect the operation and staffing levels in Universities
- On a more positive note, the crisis might give scope for new developments and technologies, including sustainable construction, introduction of sensor technology in building, new materials, etc
- In addition, public investment, in infrastructure, housing and so on, may be seen as a way out of the economic crisis.

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