AC 2007-1992: THE CIVIL ENGINEER DOES NOT EXIST ? INNOVATIVE CHANGES IN EDUCATION ARE NECESSARY IN EUROPE

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There is no standard Civil Engineer
– Innovative Changes in Education are necessary in Europe -

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1. Introduction

All over the world numerous, magnificently and differently shaped buildings, bridges, open spaces, streets etc. can be found and admired. Every country in the world features such civil engineering products, recently built or hundreds of years old. They are built by civil engineers, even though they are often dedicated to architects only, and these civil engineers were influenced by totally different educational backgrounds, learning approaches and professional development and experience as well as culturally very different surroundings.

This was and always will be the case. So it is true to say that there is no standard civil engineer. Why then are innovative changes necessary in the civil engineering education? What especially is the European answer?

2. Definition of a Civil Engineer

To answer the above question it is necessary to know who is or what it means to be a civil engineer. One of the many ways to define a civil engineer is as follows:

A civil engineer is an academically educated and practice-oriented professional who has and uses scientific, technical and other pertinent knowledge and skills to create, enhance, operate and maintain safe and efficient buildings, processes or devices of practical and economic value, for industry and the community.

3. The Professional Formation Framework of Civil Engineers in Europe

The definition given is part of the declaration of the European Council of Civil Engineers (ECCE) and the European Council of Engineering Chambers (ECEC) to describe and create a common platform for civil engineers within the European Union (EU). These two non-profit organizations represent about 800 000 civil engineers in 24 countries within Europe.

One of their objectives is to provide the possibility for all European civil engineers to live and work or to provide services in other EU member states. The basis for this approach is the EU-directive 2005/36/EC on Professional Qualification [1].

The directive very much influences the education, formation and professional development of – not only – civil engineers and therefore led to "The Professional Formation Framework of Civil Engineers of ECCE/ECEC" that has been devised

- to be definite, transparent, directly applicable and objectively reviewed;
- to contain sufficient flexibility to meet the national requirements of the different Member States;
- to take into account the two different education/training levels at institutions

of higher education as described in the directive;
- to follow the descriptions and educational requirements of the Bologna process in the European Higher Education Area (EHEA);
- to apply criteria of professional education according to outcomes and competencies instead of just education time;
- to be based on a combination of elements of education, training and professional experience;
- to define minimum conditions of professional postgraduate experience;
- to recognize rules of professional conduct;
- to be equivalent and/or comparable to other national or international (civil) engineering platforms.

So ECCE and ECEC offer ways to fulfill the requirements of a common two-level platform (Master, Bachelor) which includes both traditional education schemes and new developments within the European Higher Education Area (EHEA) on the academic side as well as existing professional practice.

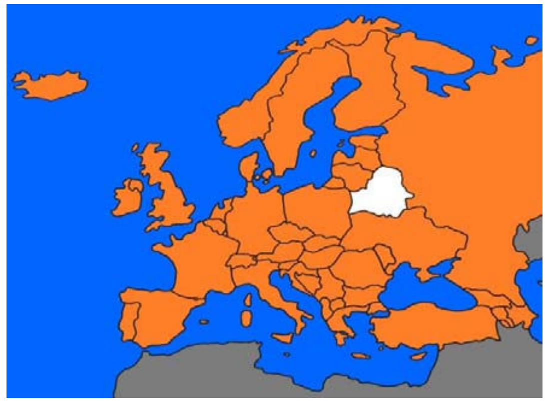
These two-level platforms are still some distance from being accepted by all the EU member states and by the EU commission itself, even if their descriptions reflect and take into account the demands of the respective directive. Concerning the many-facetted character of civil engineering in Europe, this is not very surprising. As an example of the diversity in recognition of civil engineering qualifications, chapter 3, annex 1 of the 2005 ECCE survey "Civil engineering Profession" [2] describes the different legislation procedures for the recognition and protection of professional titles. – It is obvious that no single civil engineer can exist in Europe when so many different legislation procedures are used.

4. Bologna Process and the European Higher Education Area (EHEA)

Although a cohesion of professional recognition procedures or a common platform for civil engineers will not be found in the immediate future, there is complete consensus in the professional civil engineering world in Europe that all qualifications, assessment and employment procedures must be in accordance with the Bologna Process.

Even though there are still serious concerns in the professional – civil engineering – world about the quality of the new education and training system, neither professional societies nor employers refuse to accept the new education system. Included here is the issue of a smooth conversion of old academic titles and diplomas into the new Bachelor and Master (and doctor) titles, which will be the only ones on the academic market in the future.

Even in the year 2005, which is five years before the obligatory change of all curricula into the Bologna system, each professional civil engineering association has accepted the system and will work with it, as annex 2 clearly shows. This chapter 1[2] shows only the data collected from all 22 ECCE members. The Bologna region (see picture 1) so far consists of 45 countries all over Europe including Russia, so all these countries have changed or will change their former academic education system into the two-tier system with all the other aspects of the Bologna process.



Picture 1: The Bologna Region

The Bologna Process which will lead to the European Higher Education Area (EHEA) received its biggest boost on June 19, 1999 in Bologna, when 29 European Ministers in charge of higher education signed the declaration on establishing the European Higher Education Area by 2010 and promoting the European system of higher education world-wide. In the Bologna Declaration [3] the Ministers affirmed their intention to:

- adopt a system of easily recognizable and comparable degrees;
- adopt a system with two main cycles (undergraduate/graduate);
- establish a system of credits (such as ECTS);
- promote mobility by overcoming obstacles;
- promote European co-operation in quality assurance;
- promote European dimensions in higher education.

Later in Prague (Czech Republic), Berlin (Germany) and Bergen (Norway) four additional topics where added:

- lifelong learning;
- student involvement;
- doctor’s degree in a third education cycle;
- enhancing the attractiveness and competitiveness of the European Higher Education Area in other parts of the world (including the aspect of trans-national education).

5. Changes in Curricula Development

The Bologna declaration is not only directed toward the national governments responsible for (higher) education, but also toward individual universities, their associations and co-operation networks. Many universities and professional organizations have started a Bologna-orientated process before having been forced to by their government.

Two–Tier System

According to the first four points of the Bologna declaration, all curricula have to be changed, renewed, adapted or totally re-structured to comply with these rules. All new academic titles may remain in the respective national language, but they are awarded only after having successfully finished a study program within a two-tier system.

The First Cycle leads to a Bachelor degree which must qualify graduates for entrance into the professional market; the key word here is employability.

The Second Cycle leads to a Master degree and can be studied after having achieved a first cycle degree in an appropriate study program. The second cycle program can be a more professionally oriented program or a more academic one.

Modularization and Study Load (ECTS)

In addition all curricula have to be taught or learned in modules, which is more an education in a series of "pieces" rather than the former more "all-in-one" approach. All modules as well as the total curriculum have to come with a description of the study load of the "normal" student. This study load is at least the time necessary for a "normal" student to fulfill the demands of the study program and to successfully finish his studies. The study load of one semester is 30 ECTS-credits, which are awarded to the successful student per semester.

- ECTS stands for European Credit Transfer (and Accumulation) System. – The basis for a normal work load is very much comparable to the normal work time in any normal profession, which is 8 hours a day, 40 – 50 hours a week and about 1,600 hours a year or more. A number of more sophisticated descriptors of workload have emerged recently.

The student accumulates these semester credit points at any European university in an appropriate study program until he has earned enough credits to be awarded the respective degree. Typically the two cycles have no definitely fixed duration. The EU directive on Professional Qualification as well as the Bologna (Follow-up) Declaration now gives a small span of duration or credits for each cycle as follows:

Cycle	**EU directive**	**Bologna**
First Cycle	Not less than 3, but not more than 4 years (which may be 3, 3 1/2 or 4 years)	180 – 240 ECTS-credits
Second Cycle	More than 4 years (but normally not more than 5 years)	90 – 120 ECTS-credits
Third Cycle (only for completion)	Not mentioned	(about 3 years) x ECTS-credits not specified

Table 1: Duration or ECTS-credits of cycles

Outcomes

All study programs have to be (re-)designed to assess the curricula and the qualification of students according to achievement. This is the most crucial change in European teaching programs in higher education, because normal education has involved teaching input only from teachers. The achievement qualification descriptors are as follows.

First cycle qualifications are awarded to students who:

- have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;

- can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study;
- have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues;
- can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences;
- have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.

Second cycle qualifications are awarded to students who:

- have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;
- can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;
- have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments;
- can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;
- have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

6. Conversion of Bologna Theory into Civil Engineering Practice

6.1 Tuning

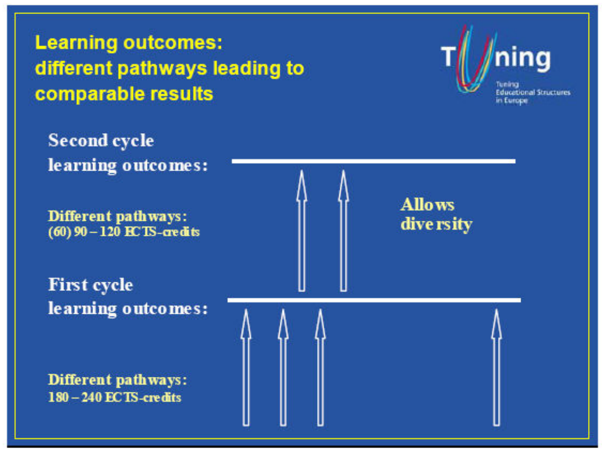
The Tuning Project[4] run by the influential European Socrates program is a tool to bring together professional demands and academic needs and possibilities within a new Bologna-shaped curriculum.

The Tuning methodology has been designed to understand curricula and to make them comparable within academia and applicable to the respective profession. Four lines of approach have been chosen for this purpose:

- generic competences;
- subject-specific competences;
- the role of ECTS as a credit giving and accumulation system and
- the role of learning, teaching, assessment and performance in relation to quality assurance and evaluation.

In the first phase of the Tuning project the emphasis has been on the first three lines. The fourth line received less attention due to time constraints, but was central in the second phase of the project. Each line has been developed according to a defined process. The starting point was updated information about the current situation at European level. This information was then reflected upon and discussed by teams of experts in the seven subject related areas. It is the work in these teams validated by related European networks that provided understanding, context and conclusions which could be valid at a European level. All together, the four lines of approach allow universities to *"tune"* their curricula without losing their autonomy and their capacity to innovate as well as their practice orientation, see picture 2.

- Furthermore Tuning has developed a model for designing, planning and implementing curricula provided jointly by one, two or more institutions, national and international (e.g. Tuning Americas).



Picture 2: Two-tier system and Tuning

6.2 EUCEET

EUCEET, the Socrates network **Eu**ropean **C**ivil **E**ngineering **E**ducation and **T**raining[5], has been involved as a member in the Tuning activities concerning civil engineering. EUCEET is one of the biggest Socrates networks, and, whenever questions arise or problems have to be solved in the professional civil engineering world in Europe, it is EUCEET which is asked first. EUCEET is now in its third phase as EUCEET III, which is almost unique in the Socrates world and which means a "life" of more than ten years of qualitative work. EUCEET III consists of about 100 university partners and about 30 national and international civil engineering societies – including ECCE – along with building companies and design offices from 29 countries. Its working period is three years up to 2009. After the end of the support from the Socrates program EUCEET will work as an independent European non-profit organization.

- Just to inform the interested reader: One of the seven current working groups has a very distinctive task. This is Group G: "**Making European Civil Engineering Education better known and more attractive outside Europe"**. ECCE is also very much involved in this work, because the author is chairman of this group and a member of the Managing Board. -

In co-operation with the Tuning project, EUCEET sent questionnaires to academic institutions, students, employers and societies about the various competences t these groups think are important in civil engineering education and training. Table 3 shows a Tuning questionnaire relating to generic competences. Questionnaires like this have been issued relating to first and second cycle degree programs.

CIVIL ENGINEERING: Generic Competences

Questionnaire for employers/societies/academics

Listed below are the 17 competences which have been considered in the project Tuning Educational Structures in Europe as most important for the professional development of university graduates, regardless of the degree and the field.

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

Please rank below **the five most important competences** according to your opinion. Please write the number of the item within the box. Mark on the first box the most important, on the second box the second most important and so on.

Table 3: Questionnaire concerning generic competences for employers, societies, academics

The results have been very interesting, sometimes very surprising, but in every case a big help in starting to renew or reshape civil engineering curricula. Due to the many EUCEET members the results are very significant. The data have been calculated using the respective statistic calculation procedures by one of the two Tuning managing universities University Deusto[4], Bilbao, Spain.

The statistical ranking data with respect to the generic competences are shown in the following tables 4 – 8. Tables 4 and 5 concern the results from academia, whereas table 6 and 7 show the results from the professional world. (The right hand side tables number the competences in the same sequence as on the left side). Table 8 at least statistically compares the results of both these questioned groups.

It is interesting that both the addressed academicians and employers came up with five separated groups of generic competences, but with different contents and different rankings. Especially regarding the knowledge area and the interpersonal skills the difference is remarkable. Nevertheless the correlation of both rankings is rather high as table 8 shows.

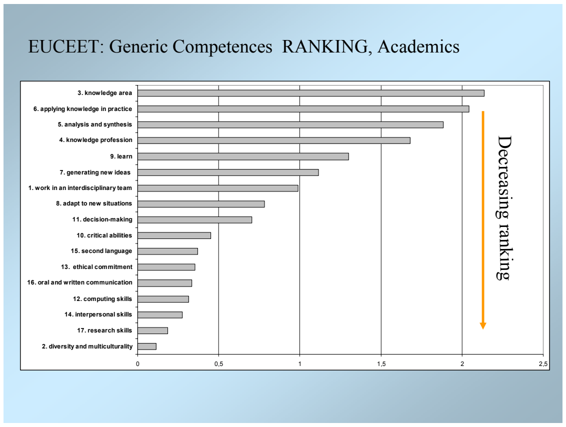


Table 4: Generic Competences Ranking Academics

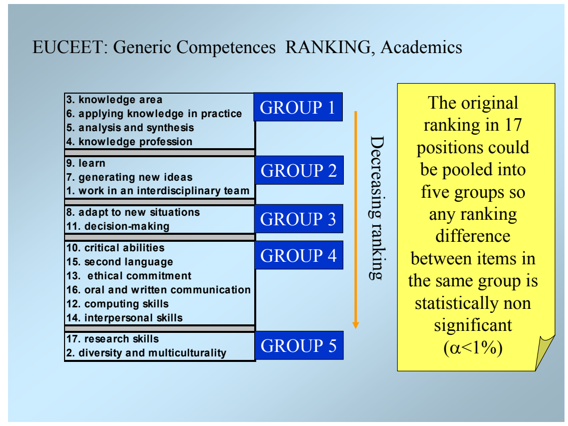


Table 5: Pooled results of table 4

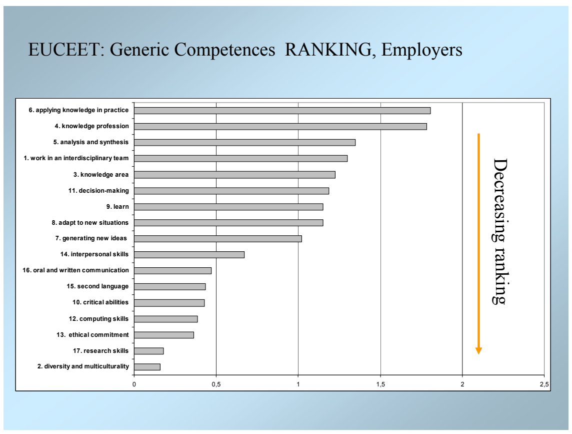


Table 6: Generic Competences Ranking Employers

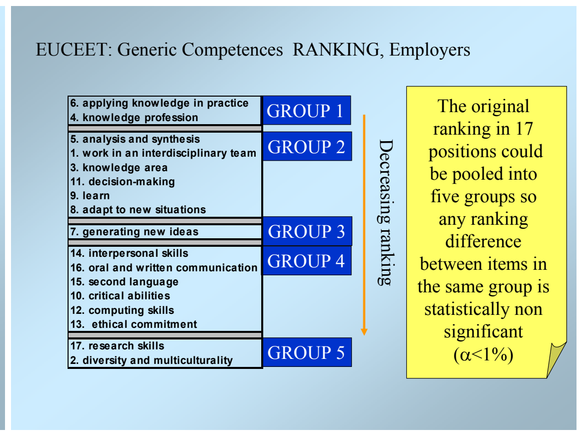


Table 7: Pooled results of table 6

	Ranking academics	Ranking employers
3. knowledge area	1	5
6. applying knowledge in practice	2	1
5. analysis and synthesis	3	3
4. knowledge profession	4	2
9. learn	5	7
7. generating new ideas	6	9
1. work in an interdisciplinary team	7	4
8. adapt to new situations	8	8
11. decision-making	9	6
10. critical abilities	10	13
15. second language	11	12
13. ethical commitment	12	15
16. oral and written communication	13	11
12. computing skills	14	14
14. interpersonal skills	15	10
17. research skills	16	16
2. diversity and multiculturality	17	17

Greatest ranking differences

Spearman correlation coefficient between both rankings

r = 0,87745098

Table 8: Correlation between the rankings as given by academics and employers

6.3 ENQA and EUR-ACE

The Bologna Declaration encourages, among the other topics mentioned, European co-operation in quality assurance of higher education with a view to developing comparable criteria and methodologies. In 2001 the European Ministers of Education meeting in Prague invited ENQA, the **E**uropean **A**ssociation for **Q**uality **A**ssurance in Higher Education[6] , to collaborate in establishing a common framework of reference for quality assurance, which would directly work towards the establishment of the European quality assurance framework by 2010. Two years later, in Berlin, the Ministers recommended ENQA, to contribute even more directly to the European quality assurance process. In the Berlin Communiqué ENQA received a double mandate from the Ministers to explore ways of ensuring an adequate peer review system for quality assurance agencies and to develop an agreed set of standards, procedures and guidelines on quality assurance.

In the Bergen meeting of May 2005 the European Ministers of Education adopted the "Standards and Guidelines for Quality Assurance in the European Higher Education Area" drafted by ENQA. The Ministers committed themselves to introducing the proposed model for peer review of quality assurance agencies on a national basis. They also welcomed the principle of a European register of quality assurance agencies based on national review.

In parallel to ENQA, EUR-ACE has been established. EUR-ACE[7] is the **Eur**opean **Ac**credited **E**ngineer EU-supported project to work out procedures and methodologies for the accreditation of engineering study programs and within the context of the Bologna follow-up activities to take a decisive step forward towards establishing a European Accreditation system/procedure for the entire engineering sector. This is mainly intended as a major tool to improve and assess quality in engineering education, as well as to increase practices of mutual trans-national recognition of engineering titles.

The main aims of the standards and procedures, and eventually a European system for accreditation of engineering education will be to

- provide an appropriate "European label" to the graduates of the accredited educational programs;
- ensure consistency between existing national "engineering" accreditation systems;
- improve the quality of educational programs in engineering;
- facilitate trans-national recognition by the label marking;
- facilitate recognition by the competent authorities, in accord with the EU Directives;
- facilitate mutual recognition agreements.

EUR-ACE finished its work at the end of last year but gave birth to the new supervising European accreditation agency for engineering programs. As written above, this agency does not work e.g. like ABET but as an agency which stipulates accreditation rules for its independent national member accreditation agencies.

In Germany ASIIN is a member of EUR-ACE. ASIIN is the German Accreditation Agency for Natural Sciences, Informatics and Engineering Curricula[8]. ASIIN is a very pro-active agency and is a provisional member of the Washington Accord. It is the right address for the many German engineering programs with an international approach regarding student mobility, joint curricula or double degrees as well as master programs within the EU and worldwide, which are supported e.g. by the German Academic Exchange Service (DAAD) Erasmus Mundus programs[9].

ASIIN is responsible only for the natural sciences, informatics and engineering programs. But considering the number of European partnerships of German universities - see table 8 below – plus cooperation projects with partners overseas, ASIIN has a lot to do just for its clients in the field of natural science and engineering. The table makes it clear that not only Germany but all Bologna countries need an organizational structure of quality assurance and accreditation procedures.

Overview: Collaborations between German universities and universities in the signatory states of the Bologna Declaration (as of 19 February 2002)			
Austria	243	Netherlands	669
Belgium	417	Norway	205
Bulgaria	29	Poland	165
Croatia	12	Portugal	332
Cyprus	3	Romania	63
Czech Republic	80	Slovak Republic	41
Denmark	310	Slovenia	12
Estonia	8	Spain	1,066
Finland	476	Sweden	453
France	1,978	Switzerland	131
Greece	313	Turkey	63
Hungary	98	United Kingdom	2151
Iceland	31	Ireland	364
Italy	1,159	Latvia	10
Lithuania	18	Luxembourg + Malta	14 + 3
Total		**10,917 (70.8 %)**	
Total of collaborations		**15,415 (100.0 %)**	

Table 8: Number of Collaborations between German universities and universities in the signatory states of the Bologna Declaration (as of 19 February 2002)

The ultimate goal of the EUR-ACE Project was to facilitate professional recognition of the engineering degrees awarded by study programs accredited on the basis of the program outcomes and accreditation criteria defined in the EUR-ACE Framework Standards. However, given different national legislative frameworks for professional recognition of engineers, these degrees cannot be considered automatically equivalent to professional

recognition. To work in the engineering profession, further qualifications (e.g. state exams) and/or training may be required in some countries or by some professional organizations.
It can be expected that engineering degrees accredited as First Cycle Degrees and Second Cycle Degrees, possibly with additional requirements, will usually lead to the levels (d) or (e) of professional qualifications, defined in Art. 11 of Directive 2005/36/EC.

7. Program Outcomes for Accreditation of Engineering Curricula (EUR-ACE)

There are six Program Outcomes of accredited engineering degree programs as follows:

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

Although all six of the Program Outcomes apply to both First Cycle and Second Cycle programs, there are important differences in the requirements at the two levels. These differences in the levels of First and Second Cycle accredited engineering programs should inform the interpretation of the Program Outcomes by Higher Education Institutions (HEI) and by accrediting panels. The differences are particularly relevant to those learning activities that contribute directly to the three Program Outcomes concerned with engineering applications, Engineering Analysis, Engineering Design, and Investigations.

Students entering an accredited Second Cycle program will normally have graduated from accredited First Cycle programs but the HEI should provide opportunities for students entering without such a qualification to demonstrate that they have satisfied the First Cycle Program Outcomes.

Integrated programs leading directly to a qualification equivalent to that of a Second Cycle qualification will need to include the Program Outcomes of both First and Second Cycle Programs.

No restriction is implied or intended by the Framework in the design of programs to meet the specified Program Outcomes. For example the requirements of more than one Program Outcome could be satisfied within a single module or unit, such as project work. Similarly it is possible that some programs are designed so that the requirements of the Transferable Skills Outcome are taught and assessed entirely within modules or units designed to satisfy the requirements of other Program Outcomes, whereas in other programs the Transferable Skills requirements are taught and assessed in modules or units designed specifically for this purpose. So, there can be no standard civil engineer!

It is envisaged that a graduate from an accredited Second Cycle program will have obtained from all HE studies a total of not less than 240 ECTS credits and a graduate from an accredited First Cycle program not less than 180 ECTS credits (or their equivalent if they graduate from HEI that do not apply the ECTS).

To understand better what is meant by distinguishing between the two cycles the following examples are given:

Knowledge and Understanding

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

First Cycle graduates should have:

- knowledge and understanding of the scientific and mathematical principles underlying their branch of engineering;
- a systematic understanding of the key aspects and concepts of their branch of engineering;
- coherent knowledge of their branch of engineering including some at the forefront of the branch;
- awareness of the wider multidisciplinary context of engineering.

Second Cycle graduates should have:

- an in-depth knowledge and understanding of the principles of their branch of engineering;
- a critical awareness of the forefront of their branch.

Engineering Analysis

Graduates should be able to solve engineering problems consistent with their level of knowledge and understanding, and which may involve considerations from outside their field of specialization. Analysis can include the identification of the problem, clarification of the specification, consideration of possible methods of solution, selection of the most appropriate method, and correct implementation. Graduates should be able to use a variety of methods, including mathematical analysis, computational modeling, or practical experiments, and should be able to recognize the importance of societal, health and safety, environmental and commercial constraints.

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 analyze 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 specialization;
- the ability to use their knowledge and understanding to conceptualize engineering models, systems and processes;
- the ability to apply innovative methods in problem solving.

Engineering Design

Graduates should be able to realize 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 artifacts, and the specifications could be wider than technical, including an awareness of societal, health and safety, environmental and commercial considerations.

First Cycle graduates should have:

- the ability to apply their knowledge and understanding to develop and realize designs to meet defined and specified requirements;
- an understanding of design methodologies, and an ability to use them.

Second Cycle graduates should have:

- an ability to use their knowledge and understanding to design solutions to unfamiliar problems, possibly involving other disciplines;
- an ability to use creativity to develop new and original ideas and methods;
- an ability to use their engineering judgment to work with complexity, technical uncertainty and incomplete information.

8. Conclusion

The Civil Engineering Profession has to deal with

Tasks like

Infrastructure, Highway Engineering, Soil Mechanics, Transportation Engineering, Foundation Engineering, Steel Structures, Structural Engineering, Building Physics, Structural Mechanics, Water Resource, Water and Wastewater Engineering, Bridge Engineering, Building Materials Technology, ……...(to be completed) and

Services like

Building supervision, Project Management, Facility Management, Construction Economics and Management, Environmental Protection, Consultation, Design, …….(to be completed).

The curricula will be designed to reflect the variety of the tasks and services and the variety of the national regulations. So, a lot of diversity in civil engineering curricula will remain. A standard civil engineer will not be educated under these circumstances. The civil engineering market will dictate the conditions, but very likely support this education system, because of the various demands within civil engineering.

The market will also dictate whether a Bachelor or a Master is needed on the building site, in a design or project planning office etc. Bachelor education can respond quickly to market demands. Teachers who become professors after having worked for at least five years in a building company and having achieved a PhD – this is the rule in Germany at the Universities of Applied Sciences - will foster this more professionally oriented approach in the first and second cycle degrees. They are close to the market, have a scientific background and by performing the thesis of the students of both cycles in co-operation with a building company or office, they remain in close contact with civil engineering market demands. Nevertheless there is enough space for Masters who are more research oriented, because there is a substantial need to promote research and development and to connect civil engineering with modern sciences and technologies.

Annex 1

Chapter 1 - THE EDUCATION SYSTEM

Questions: *General Education System*
Environmental Training within Civil Engineering Education
Bologna Process
Foreign Language Learning

COUNTRY	***Education System***	***Environmental Training***	***Bologna Process***	***Foreign Language***
Croatia	4.5 y. BA (Grad.Civ.Eng.) 2 y. Master, also 3 y. Civ.Eng.(Technical High School)	Yes, compulsory and voluntary	3+2+3 (Bachelor-Master-PhD), also 4+1+3 system, starting 2005/6	Engl.+German obligatory / others optional
Cyprus	3 y. Technician Engineer New courses at new University	Part of education, even courses Civ.Eng. and Environment	Totally in new Univ. since 2003	English obligatory, others optional
Czech Republic	5 years	Very important specialties, but also embedded	4+1+X since2003/4	English obligatory, others optional
Estonia	4 y. Technical Institute 5 y. University	Embedded	(3+2=) 5 years since 2002	English obligatory, others optional
Finland	> 5 y. Technical University 4 y. Polytechnics	Obligatory modules, much emphasis	3+2+X from 2005/6	Swedish,English, (German)
France	5 years Ingénieur Diplôme	No specific studies, embedded	3, 5, 8-system in progress	English and others voluntary
Germany	> 5 y. Technical University 4 y. Fachhochschule	No specific studies, embedded	3+2+3 or 3 ½ + 1 ½ +3 mostly 2005/6	English mandatory, Others: French, Spanish, Chinese
Greece	5 y. of universities	No specific studies, Embedded	Not yet installed	Voluntary
Hungary	5 y Technical University 3 y Institute of Technology	Embedded	4+1, 5+3 mostly 2005/2006	Voluntary
Ireland	5 y. at University 4 y. at Institute of Technology	Embedded	(3+2=) 5 years integrated Master	Voluntary
Italy	3 y. Laura 5 y. Laura specialistica	Embedded	3+2 since 2000	Voluntary
Latvia	4.5 Bachelor+1 Master since 2004	Embedded	Implemented since 1996	English (mainly) or German
Lithuania	4 Bachelor+2 Master since 2000	Uni. Of Vilnius special Environment. Faculty	In work	voluntary
Poland	5.5 y. Master	Number of specific curricula	5 y. Engineer and 3+2 (Bach./Master)	Yes, various
Portugal	5 y. University 3 y. Polytechnic	Mandatory modules	3+2 or 4+1 not yet decided	Foreign language from school
Romania	3 y. Inginer colegiu 5 y. Inginer diplomat	Special curricula, no mandatory modules	3-4 + 2-1 from 2005/6	Russian, now Engl. and others

Russia	5.5 y. Dipl. Engineer 4+2 Bachelor to Master Academic	Embedded	4+1 or 4+2, for special program 5+2 from 2007/8	English, also German, others voluntary
Slovak Republic	5 years	Embedded, study program at some faculties of civil engineering	3-4 (Bachelor) + 5 (Master) + 3 (PhD.)	One foreign language subject is mandatory (English, German or French)
Slovenia	4 y. of universities	Included in some obligatory courses		Usually two foreign languages
Spain	5 years (6 years) Escuela de Caminos (university)	No mandatory modules, some optional	4 years + 6 months End of Career Project + 1 or 2 yr Master +Doctoral Degree	English mandatory, others optional
Turkey	4+2-tier system 4+2 Bachelor/Master	Embedded	4+2 like before 4+1 (without thesis)	English at school, German by family contacts
United Kingdom	3 y. BEng+Matching 4 y. MEng/BEng (hon.)	Numerous obligatory modules normally embedded	No movements	Some offers, but not mandatory

Annex 2

Chapter 3 - RECOGNITION AND PROTECTION OF PROFESSIONAL TITLE

Questions: *Is there any legislation in your country that obliges you to have a certain qualification in order to carry out the profession of civil engineer?*
Is the title of "civil engineer" or "Graduate Engineer" or similar, protected under law?

COUNTRY	*Legislation*	*Protection of title by law*
Croatia	Yes, by Building Law (2003) Formal requirements	Yes Civil Engineer, Graduate Civil Engineer
Cyprus	Yes, by authorization of Cyprus Technical Chamber	Yes Civil Engineer
Czech Republic	Yes authorization by Chamber	Yes, Bachelor of Science, Master of Science
Estonia	Since 2003 title of Bachelor and Master of Science	Yes, Civil Engineer, Applied Engineer
Finland	Yes, by Building and Land Use Law to "quality requirements"	Yes, Engineer
France	No no protection of title of Civil Engineers	Yes "Ingénieur Dimplômé de l'Ecole de ....". No, for all others.
Germany	Yes, (Law of Bundesländer) Diplom-Ingenieur (Dipl. Ing.)	Yes, (Law of Bundesländer) Diplom-Ingenieur (Dipl. Ing.)
Greece	Yes, By law 4663/1930	yes
Hungary	Yes	Yes
Ireland	Yes	Yes, Chartered Engineer

Italy	Yes Royal Decree, Art. 167(31 Aug. 1933)	Yes Ingegnere Civile e Ambientale (iunior), Ingegnere Industriale (iunior)
Latvia	Yes. Building Law, Law on higher education	Yes Engineer, Bachelor, Master, Dr.sc.ing.
Lithuania	Yes	Yes, Bachelor and Master of Science
Poland	Yes	Yes
Portugal	Yes, Authorization by Ordem dos Engenheiros	Yes Civil Engineer
Romania	No	No
Russia	Yes	Yes, Civil Engineer, Bachelor and Master Academician
Slovak Republic	Yes Authorization by the Slovak Chamber of Civil Engineers Act No. 138/1992 Coll. on Authorized Architects and Authorized Civil Engineers	Yes The title "Authorized Civil Engineer" is protected under law (authorization is issued by the Slovak Chamber of Civil Engineers)
Slovenia	Yes, Accord. to ZGO and special examinations	Yes, And after completion of university studies
Spain	Yes	Yes
Turkey	No	No
United Kingdom	No but authorization by ICE	Yes Chartered Engineer, Corporate Engineer, Engineering Technician

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3 www.bologna-bergen2005.no Bologna Declaration and follow-up activities
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6 www.enqa.eu European Association for Quality Assurance in Higher Education (ENQA)
7 www.feani.org European Accredited Engineer (EUR-ACE) at FEANI website
8 www.asiin.de German Accreditation Agency for Natural Sciences and Engineering Curricula (ASIIN)
9 www.daad.de German Academic Exchange Service (DAAD)

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