European Council of Civil Engineers

Standing Committee on Education & Training

Participation of ECCE in the European project EUGENE (European and Global Engineering Education)

Prof. Iacint Manoliu
Contact person of ECCE in EUGENE

54th ECCE meeting
Antalya, 28 October 2011

EUGENE Academic Network
EUropean and Global ENgineering Education
01.10.09-30.09.12
155980-LLP-1-2009-1-IT-ERASMUS-ENWA

EUGENE
EUROPEAN AND GLOBAL ENGINEERING EDUCATION
01.10.09-30.09.12
155980-LLP-1-2009-1-IT-ERASMUS-ENWA

a new TN (Academic Network in LLP) with the main goal of improving the impact of EEE on competitiveness, innovation and socio-economic growth in a global context

Five main activity lines

***A) Ph. D. STUDIES*:** Structure and Bologna follow-up in the competitiveness issues (main question: are Ph D studies in Engineering and Technology in Europe effective/innovative/competitive enough?)

The purpose of this Activity Line will be to collect information on the experience with different doctoral programmes and formulate recommendations for the future.

B) PROMOTE EE IN EUROPE AS A TRUE RESEARCH FIELD (with comparison of worldwide developments in EER …): a true and innovative research area to improve entrepreneurship, innovation and competitiveness;

A second Activity Line is targeted to promote the recognition in Europe, as it already happens in other regions of the world, of *EE as a true research area*. In fact in order to develop the potential of European Higher Education institutions it is of paramount importance to identify aspects of the learning
process where innovation is needed, putting in place the required research activities.

***C) IMPROVE transnational MOBILITY* of engineering students, graduates and professionals**

This item will involve two main aspects:

Ca) Within EHEA: Checking and improving the applicability and consistency (in the Engineering field) of European Qualification Frameworks, EU Directive on Recognition of Professional Qualifications, Accreditation Standards and other relevant "European" documents.
Deliverable output(s): Revised documents, tested during the project.

Cb) On the global scale: Comparison of the “European” documents with other documents and agreements (Washington and other Accords in the IEA, but also regional and national Standards in other parts of the world: e.g. North Africa, S.E. Asia, Latin America); tentative agreements for mutual recognition.

Both aspects should involve not only the “academic” side, but also the “professional training” (and “Vocational education and training”).

ECCE Contact person in EUGENE, Prof. Iacint Manoliu, is involved in the activities of the Line C.

D) LLL & CONTINUING EDUCATION as a tool to improve competitiveness and innovation of European engineers

The purpose of this Activity Line is by the help of benchmarking good practices and analyzing the latest university research results in this focus area to conceptualize the needed actions in the university-industry collaboration. Special focus is on the modern use of ICT and the orchestration of the activities to increase synergy between and through that societal impact of research, teaching and the third mission operations.

E) INCREASE ATTRACTIVENESS of studies in science and engineering and to EHERA: involve students organisations (ERASMUS Mundus Network, TEMPUS Mediterranean, as follow-up …) and promote awareness outside the EU of EE evolution and opportunities;

E1: Aim: Identify examples of good practice enhancing the attractiveness of engineering as a career both to traditional and non-traditional groups. The focus will be on attracting students of the right quality to both Bachelor and Masters degrees.

E2: Aim: Compilation of employability attributes in engineering graduates and identification of good practice for embedding these in engineering curricula.

E3: Aim: Promotion of Engineering Education in the EU outside the EHEA including the identification of examples of good practice for increasing the number and quality of non-EU students on engineering programmes in the EHEA.

Activities under the EUGENE Line C

❑ Meetings

- At the First Scientific Committee and Kick off meeting, Florence, 21 December 2010 the Line C was founded, under the Chairmanship of Prof. Giuliano Augusti
- The initial meeting: Brussels, 20 February 2010
- The second meeting: Rome, 23 March 2011
- The third meeting Lisbon, 28 September 2011

❑ Workpackages of EUGENE Line C

Work Package 7
European Engineering Standards and Qualification Frameworks

Deliverable 22 **Discussion on paper "High Level Qualifications Frameworks and the EUR-ACE Framework Standards – do they fit together?"**

Deliverable 23 Public Discussion on first draft of WP7 Final Report.
This discussion is scheduled to take place before May 2012.

Deliverable 24 High Level European Qualifications Frameworks and Engineering Standards: a critical comparative review and suggestions for improving applicability and consistency"
This report, to be produced in September 2012, will include the outcomes of the discussions in Deliverables 22 and 23. It will also take into account the response of ENAEE to the Public Consultation on the Recognition of the Professional Qualifications Directive that has been circulated by the European Commission.

Work Package 8

Comparison of EUR-ACE and International Engineering Alliance Standards (Line C)

Deliverable 45 Updated version of the Glossary of Terms Relevant to Higher Education (Engineering) – NOT FORESEEN IN THE ORIGINAL APPLICATION

This deliverable is added to the project because it was recognised as a valuable adjunct to the comparative study of the EUR-ACE and International Engineering Alliance (IEA) standards. A small working group, including Prof. Iacint Manoliu, has met three times to develop a common glossary. In addition to representatives of the ENAEE and ECCE the group included a representative of the IEA. A final version of the Glossary is in preparation and it is intended that this will be sent to the Administrative Council of the ENAEE and the next meeting of the IEA for approval as a working document.

The draft was presented in an open discussion at the World Engineering Education Flash Week in Lisbon in September 2011.

Deliverable 25 Public Discussion on first draft of WP8 Final Report
The first draft was presented for the public discussion in September 2011 in Lisbon. The Glossary developed in Deliverable 45 was part of the discussion.

Deliverable 26 Comparison of the EUR-ACE Standards and the requirements of the Washington and Sydney Accords. This report, due in March 2012, will incorporate the outcomes of Deliverables 25 and (in part) 45.

Work Package 9

Engineering Standards Worldwide

Deliverable 27 Engineering Standards worldwide; a comparative collection.

This Work Package began in October 2010, and initial work has focused on contributing to an important project led by OECD (Organization for Economic Co-operation and Development). This project, Assessment of Higher Education Learning Outcome (AHELO), is a feasibility study to investigate the development of assessment methods for higher education that would be globally 'valid for all cultures and languages'. This project is complementary to the work of EUGENE Work Package 9 as engineering is one of the two academic subjects in the present feasibility study.

Work Package 10

Mutual recognition of engineering degrees and qualifications

Deliverable 28 Proposals for Mutual recognition of engineering degrees and qualifications

This Work Package will be completed in September 2012.

Contribution to the Work Package 7

High Level Qualifications Frameworks and the EUR-ACE Frameworks Standards – do they fit together?

S. Feyo de Azevedo

Ordem dos Engenheiros – Engineers Portugal;
Departamento de Engenharia Química, Faculdade de Engenharia, Universidade do Porto, Portugal,
sfeyo@fe.up.pt

Qualifications Frameworks – what they are and how they relate between each other

Strictus sensus a Qualifications Framework (QF) is, essentially, a systematic description of an education system, expressing the expected learning outcomes for a given qualification, that is expressing what a learner is expected to know, understand and be able to do after successful completion of a process of learning.

A QF should describe all the qualifications in a higher education system, or in an entire education system if the framework is developed for this purpose. It also shows how the various qualifications in the education or higher education system articulate and how learners can move between qualifications. QF thus focus mainly on outcomes and on the several learning paths, including those of lifelong learning, that may lead to a given qualification.

QF based on Learning Outcomes (LO) represent a cornerstone of the reforms proposed within the Bologna Process - they play a major role in basically all main structural areas of the reform:
(i)in developing degree systems and study programmes at higher education institutions;
(ii)(ii) in the recognition of qualifications, by all stakeholders; and
(iii)(iii) as a pre-requirement, in the implementation of Quality Assurance systems.

Qualifications Frameworks and descriptors at different levels of detail

Meta Qualifications Frameworks and related high level descriptors

These characterize high level groups of qualifications. They are generally developed at institutional level of governments and stakeholders. They may differ in background and objectives. As such, different frameworks may arise (have arisen), employing different sets of descriptors, or grouping such descriptors in different clusters of outcomes.

At European level, two main frameworks are currently in place:
(i) The Qualifications Framework for the construction of the European Higher Education Area (QFEHEA, 2005), approved by the 46 signatory countries of the Bologna Process.
The QF-EHEA focus on the post-secondary education system and adopts the well known Dublin Descriptors that identify four cycles of higher education (three main cycles plus short cycles within or linked to First Cycles). Table 1 identifies the five building blocks that form the structure of the Dublin Descriptors. Table 2 presents the relations between the levels of qualifications adopted in the different frameworks and in the Directive. Tables 3 to 5 detail the descriptors for each of the respective levels.

(ii) The European Qualifications Framework for Lifelong Learning (EQF-LLL, 2008), a Recommendation of the European Parliament and of the Council, approved on April 23, 2008.
The EQF-LLL aims at describing the entire education system, recommending eight levels of qualification, each identified by descriptors grouped in the three main clusters of outcomes presented in Table 1 and detailed in Tables 3, 4 and 5.

Table 1 – Clustering of qualifications descriptors in different frameworks Bologna, QF-EHEA EU, EQF-LLL EUR-ACE

Bologna, QF-EHEA	EU, EQF-LLL	EUR-ACE
A. Knowledge and understanding	1. Knowledge	I. Knowledge and understanding
B. Applying knowledge and understanding	2. Skills	II. Engineering analysis
C. Making Judgments	3. Competences	III. Engineering design
D. Communications skills		IV. Investigations
E. Learning skills		V. Engineering practice
		VI. Transferable skills

Table 2 – Relating levels of qualifications in different frameworks

Bologna, QF-EHEA	EU, EQF-LLL	EUR-ACE	EU Directive 2005/36
Short Cycles (ShC)	Level 5 (L5)		Art. 11 c)
First Cycles (FC)	Level 6 (L6)	First Cycles (FC)	Art. 11 d)
Second Cycles (SC)	Level 7 (L7)	Second Cycles (SC)	Art. 11 e)
Third Cycles (TC)	Level 8 (L8)		

Sectoral Frameworks.

Sectoral frameworks are concerned with specific discipline descriptors and ideally result from wide transnational co-operation and agreements between stakeholders, namely higher education institutions and professional associations. Sectoral frameworks should naturally relate to and be identified within the wide descriptors of the meta frameworks, but they quite clearly are expected to be more detailed in the descriptions. Depending on the sector of knowledge, they may be further subdivided in sub-sectors characterized by specific domain descriptors, including, if applicable, the identification of professional activities for which the candidates are to be prepared. Engineering is a good example of a sector that requires specific domain descriptors, related to the different specialties.

Table 3 – Comparison of descriptors – QF-EHEA Short Cycles and EQF-LLL - Level 5

Bologna, QF -EHEA Short Cycles	EU, EQF-LLL Level 5
ShC-A. Have demonstrated knowledge and understanding in a field of study that builds upon general secondary education and is typically at a level supported by advanced textbooks; such knowledge provides an underpinning for a field of work or vocation, personal development, and further studies to complete the first cycle; ShC-B. Can apply their knowledge and understanding in occupational contexts; ShC-C. Have the ability to identify and use data to formulate responses to well-defined concrete and abstract problems; ShC-D. Can communicate about their understanding, skills and activities, with peers, supervisors and clients; ShC-E. Have the learning skills to undertake further studies with some autonomy.	L5.1. Comprehensive, specialized, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge. L5.2. A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems L5.3.1. Exercise management and supervision in contexts of work or study activities where there is unpredictable change; L5.3.2. Review and develop performance of self and others.

Table 4 – Comparison of descriptors – QF-EHEA First Cycles, EQF-LLL - Level 6 and EUR-ACE First Cycles

Bologna, QF–EHEA, First Cycles	EU, EQF-LLL, Level 6	EUR-ACE, First Cycles
FC-A. 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 **FC-B.** 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 **FC-C.** 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 **FC-D.** Can communicate information, ideas, problems and solutions to both specialist and nonspecialist audiences **FC-E.** Have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.	**L6.1.** Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles; **L6.2.** Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialized field of work or study **L6.3.1.** Manage complex technical or professional activities or projects, taking responsibility for decisionmaking in unpredictable work or study contexts **L6.3.2.** Take responsibility for managing professional development of individuals and groups	**FC-I.1.** Knowledge and understanding of the scientific and mathematical principles underlying their branch of engineering; **FC-I.2.** A systematic understanding of the key aspects and concepts of their branch of engineering; **FC-I.3.** Coherent knowledge of their branch of engineering including some at the forefront of the branch; **FC-I.4.** Awareness of the wider multidisciplinary context of engineering. **FC-II.1.** The ability to apply their knowledge and understanding to identify, formulate and solve engineering problems using established methods; **FC-II.2.** The ability to apply their knowledge and understanding to analyse engineering products, processes and methods; **FC-II.3.**the ability to select and apply relevant analytic and modeling methods. **FC-III.1.** The ability to apply their knowledge and understanding to develop and realize designs to meet defined and specified requirements; **FC-III.2.** An understanding of design methodologies, and an ability to use them. **FC-IV.1.** The ability to conduct searches of literature, and to use data bases and other sources of information; **FC-IV.2.** The ability to design and conduct appropriate experiments, interpret the data and draw conclusions; **FC-IV.3.** Workshop and laboratory skills. **FC-V.1.** The ability to select and use appropriate equipment, tools and methods; **FC-V.2**. The ability to combine theory and practice to solve engineering problems; **FC-V.3.** An understanding of applicable techniques and methods, and of their limitations; **FC-V.4.** An awareness of the non-technical implications of engineering practice. **FC-VI.1.** Function effectively as an individual and as a member of a team; **FC-VI.2.** Use diverse methods to communicate effectively with the engineering community and with society at large; **FC-VI.3.** Demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice; **FC-VI.4.** Demonstrate an awareness of project management and business practices, such as risk and change management, and understand their limitations; **FC-VI.5.** Recognize the need for, and have the ability to engage in independent, life-long learning.

Table 5 – Comparison of descriptors - QF-EHEA Second Cycles, EQF-LLL - Level 7 and EUR-ACE Second Cycles

Bologna, QF-EHEA, Second Cycles	EU, EQF-LLL, Level 7	EUR-ACE, Second Cycles
SC-A. 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; **SC-B.** 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; **SC-C.** 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; **SC-D.** Can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non specialist audiences clearly and unambiguously; **SC-E.** Have the learning skills to allow them to continue to study in a manner that may be largely selfdirected or autonomous.	**L7.1.1.** Highly specialized knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research; **L7.1.2.** Critical awareness of knowledge issues in a field and at the interface between different fields. **L7.2.** Specialized problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields. **L7.3.1.** Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; **L7.3.2.** Take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams;	**SC-I.1.** An in-depth knowledge and understanding of the principles of their branch of engineering; **SC-I.2.** A critical awareness of the forefront of their branch. **SC-II.1.** The ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications; **SC-II.2.** The ability to formulate and solve problems in new and emerging areas of their specialization; **SC-II.3.** The ability to use their knowledge and understanding to conceptualize engineering models, systems and processes; **SC-II.4.** The ability to apply innovative methods in problem solving. **SC-III.1.** An ability to use their knowledge and understanding to design solutions to unfamiliar problems, possibly involving other disciplines; **SC-III.2.** An ability to use creativity to develop new and original ideas and methods; **SC-III.3.** An ability to use their engineering judgment to work with complexity, technical uncertainty and incomplete information. **SC-IV.1.** The ability to identify, locate and obtain required data; **SC-IV.2.** The ability to design and conduct analytic, modelling and experimental investigations; **SC-IV.3.** The ability to critically evaluate data and draw conclusions; **SC-IV.4.** The ability to investigate the application of new and emerging technologies in their branch of engineering. **SC-V.1.** The ability to integrate knowledge from different branches, and handle complexity; **SC-SC-V.2.** A comprehensive understanding of applicable techniques and methods, and of their limitations; **SC-V.3.** A knowledge of the non-technical implications of engineering practice. **SC-VI.1.** Fulfill all the Transferable Skill requirements of a First Cycle graduate at the more demanding level of Second Cycle; **SC-VI.2.** Function effectively as leader of a team that may be composed of different disciplines and levels; **SC-VI.3.** Work and communicate effectively in national and international contexts.

A note on organization of the engineering profession and education systems

The two levels of education primarily identified as 'higher education for the professions' are the First and Second Cycles of the QF-EHEA that correspond to Levels 6 and 7 of the EQF-LLL (Table 2).

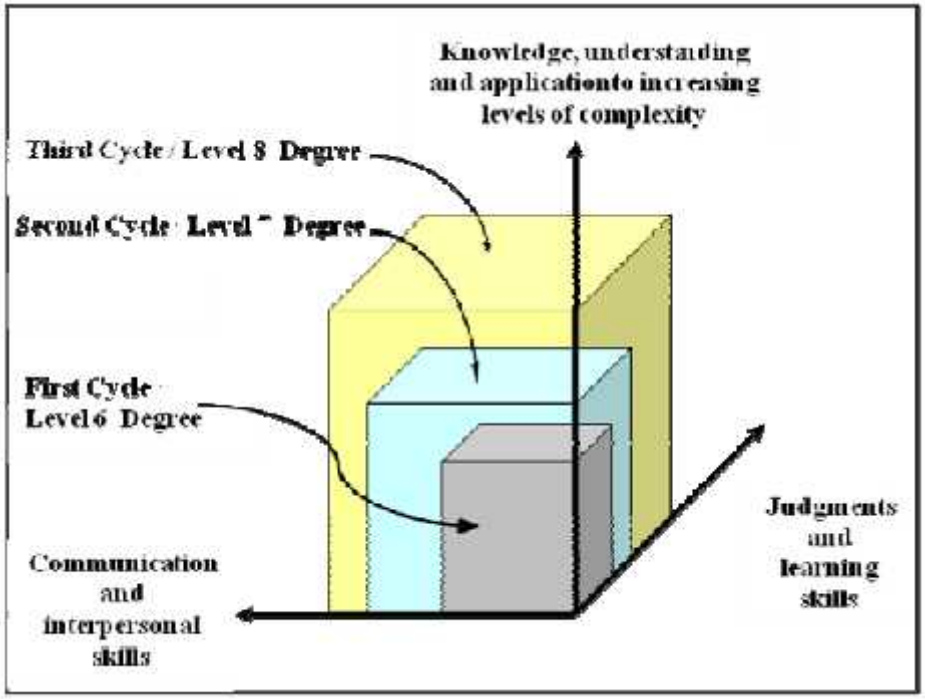

Fig. 1 – Expected Progression in Learning Outcomes along the degree system

Fig. 1 presents the 'wishful thinking' of a degree system designed for maximizing employability potential of First Cycle graduates. This is generally the concept that presides to the QF-EHEA. First Cycles contain essential all the basic desired learning outcomes relevant to the professions, these being enlarged and matured from cycle to cycle.

In engineering, a scientific but also technical domain where a binary system of education makes sense and exists in several countries, the discussion has been significant, in recent years, about levels and profiles of required education in engineering, namely on the type of First Degrees that should be awarded by Higher Education Institutions.

Though not all Countries share the same views, it is today recognized that two levels of engineering education and two main types of degree profiles, relevant to the profession, are available in the European countries, in possible trajectories as illustrated in Fig. 2.

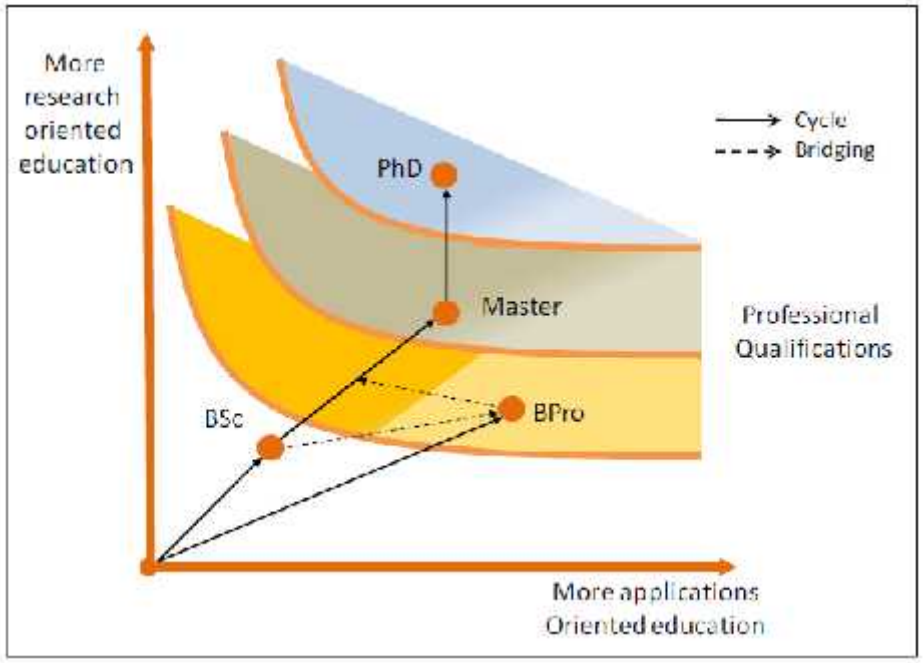

Fig. 2 - Different profiles for engineering education, assuming professional vs. academic first cycle degrees

The levels are directly related to the expected qualifications of the professionals and to the expected engineering activity, both evaluated in direct relation to relevant technical, scientific and social aspects, such as having:
(i) social responsibility (namely signing of projects, of which those in structural engineering are possibly the most relevant); (ii) recognised capacity to tackle large,
complex problems;
(iii) capacity to adapt to new jobs of high complexity and responsibility;
(iv) capacity for effective activity in the production line; and, not the least,
(v) the right attitude to use knowledge and skills in a given situation.

Qualifications Frameworks – do they fit together?

Inspection of Tables 4 and 5 indicate that, as expected and perceivable, the descriptors for the sectoral framework (EUR-ACE) are significantly more detailed than those of the meta frameworks.

Figs. 3 and 4 were constructed from the analysis of descriptors presented in those Tables and put in evidence that it is possible to relate the different descriptors adopted

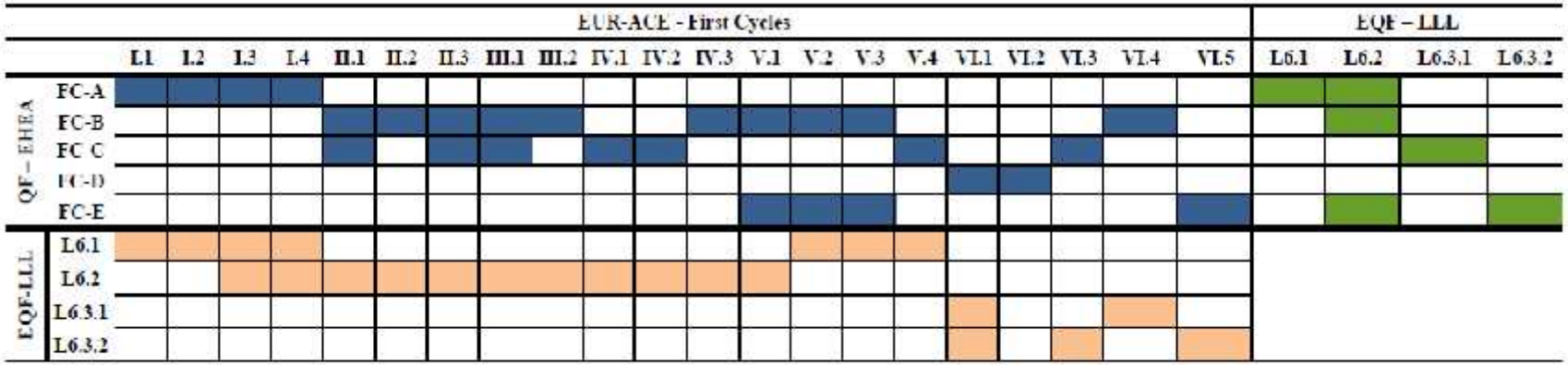

Fig. 3 - Relation between framework descriptors for First Cycle degrees (EQF-LLL - Level 6)

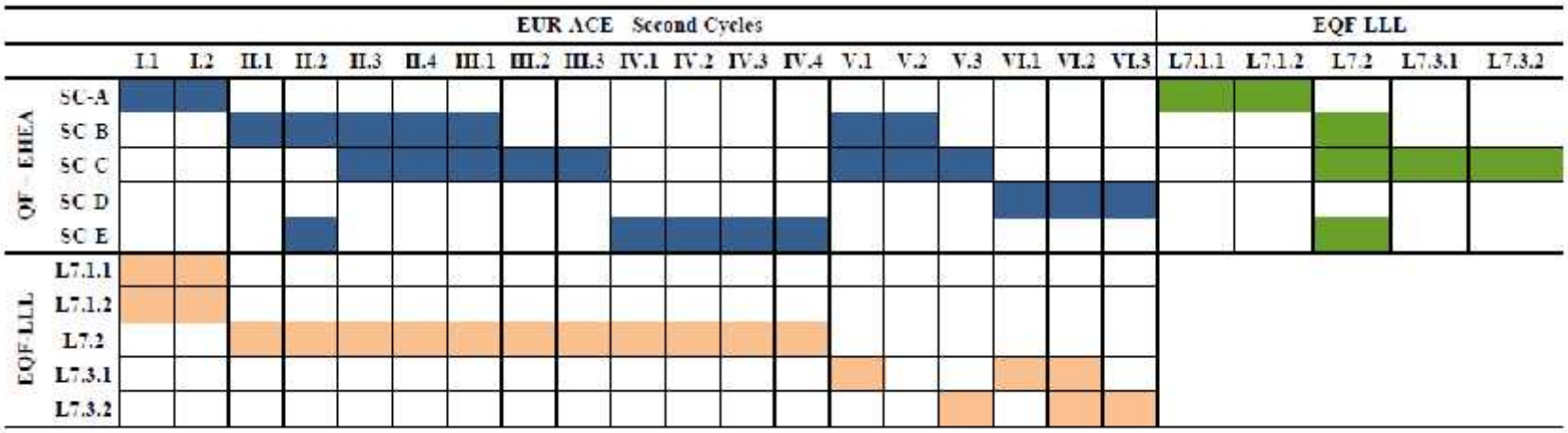

Fig. 4 - Relation between framework descriptors for Second Cycle degrees (EQF-LLL - Level 7)

Conclusions

QF based on Learning Outcomes (LO) represent a cornerstone of the reforms proposed within the Bologna Process - it plays a major role in basically all main structural areas of the reform:
(i)in developing degree systems and study programmes at higher education institutions;
(ii)in the recognition of qualifications, by all stakeholders; and
(iii)as a pre-requirement, in the implementation of Quality Assurance Systems.

So, the answer to the starting question is Yes. EUR-ACE fits well both ‘up and downstream’: upstream, its descriptors are seen as within or closely related to the descriptors of the meta frameworks of the European space; downstream, its outcomes are being employed at specialty level as qualification frames for degree courses.

References

ABET (2009), The ABET criteria for accrediting engineering programmes, available in the ABET site (www.abet.org) at http://www.abet.org/Linked%20Documents-UPDATE/Criteria%20and%20PP/E001%2009 10%20EAC%20Criteria%2012-01-08.pdf (active on 12 January 2009)

Augusti, G. (2007a), Accreditation of engineering programmes: European perspectives and challenges in a global context, European Journal of Engineering Education, 32 3, 273-283 (available at www.enaee.eu, active on 12 January 2009)

Augusti, G. (2007b), Accreditation of engineering programmes at European level, Int. Journal of Electrical Engineering Education, 44 2, 101-108

Augusti, G. (2009): EUR-ACE: the European Accreditation system of engineering education and its global context; in "Engineering Education Quality Assurance: A Global Perspective" (P. Gray and A. Patil, editors), Springer Science+Business

Bergan, S. (2007), Qualifications – Introduction to a concept, Council of Europe Higher Education series No. 6, Council of Europe Publishing, Strasbourg (http://book.coe.int, active on January 12, 2009)

Berggren, K-L, Brodeur, D., Crawley, E., Ingemarsson, I., Litant, W., Johan Malmqvist, J. and Östlund, S.(2003), CDIO: An International Initiative for Reforming Engineering Education, World Transactions on Engineering and Technology Education, 2 1, 49-52

CDIO (2001), The CDIO Initiative, available in the CDIO site at www.cdio.org (active on 12 January 2009)
Directive (2005), DIRECTIVE 2005/36/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, on the recognition of professional qualifications, 7 September 2005, available in the site of the Official Journal of the European Union at

ECCENET (2006), EUCEET II - European Civil Engineering Education and Training II, European Council of Civil
Engineers, available at http://www.eccenet.org/Activities/Edu-Train.html (active on 12 January 2009)
EFCE (2005), European Federation of Chemical Engineering (EFCE) Recommendations for Chemical Engineering
Education in a Bologna Two Cycle Degree System, 2005, available in the site of the EFCE at www.efce.info/Bologna_Recommendation.html (active on 12 January, 2009)

EQF-LLL (2008), The European Qualifications Framework for Lifelong Learning (EQF), Recommendation of the
European Parliament and of the Council, 23 April 2008, available in the site of the European Commission at http://ec.europa.eu/education/lifelong-learning-policy/doc44_en.htm (active on 12 January 2009)

EU (2008) European Commission - Database of regulated professions in the EU Member States, Iceland, Norway,
Liechtenstein and Switzerland, available at
http://ec.europa.eu/internal_market/qualifications/regprof/index.cfm (active on 12 January 2009)

EUR-ACE (2006a), EUR-ACE Framework Standards for the Accreditation of Engineering Programmes, available in
the site of the ENAEE-European Network for Accreditation of Engineering Education at http://www.enaee.eu/images/P1%20EUR-ACE_Framework%20Standards%2028.08.08.pdf (active on 12 January 2009)

EUR-ACE (2006b), Commentary on EUR-ACE Framework Standards for the Accreditation of Engineering Programmes, available in the site of the ENAEE-European Network for Accreditation of Engineering Education at http://www.enaee.eu/images/P2%20Commentary%20on%20EURACE_ Framework%20Standards%2028.08.2008.pdf (active on 12 January 2009)
Gagneur, S., CHEMEPASS (2009) – Chemical Engineering Mobility Tools, 8th World Congress of Chemical

QF-EHEA (2005), A Framework for Qualifications of the European Higher Education Area, Bologna Working Group on Qualifications Frameworks, Ministry of Science, Technology and Innovation, Denmark, available in the site of the Bologna Follow-up Group at
http://www.ond.vlaanderen.be/hogeronderwijs/bologna/documents/QF-EHEA-May2005.pdf (active on 12 January 2009)

SGQA (2005), Standards and Guidelines for Quality Assurance in the European Higher Education Area, European
Association for Quality Assurance in Higher Education, Helsinki, 2005. Available at
http://www.enqa.eu/files/BergenReport210205.pdf (active on 12 January 2009)

TUNING (2000), TUNING Educational Structures in Europe, available at http://tuning.unideusto.org/tuningeu (active on 12 January 2009).

VDI-GVC (2008), Recommendation for the development of consecutive Bachelor's and Master's courses, 2nd Rev.
Ed., VDI-Society for Chemical and Process Engineering, Dusseldorf, Germany, available in the site of VDIGVC
at:
http://www.vdi.de/fileadmin/vdi_de/redakteur_dateien/gvc_dateien/VDI%20Curricula%20englischalleine.pdf (active on 12 January, 2009)