



Sectoral Frameworks and Quality Assurance in Engineering Education

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To say what I am going to say...

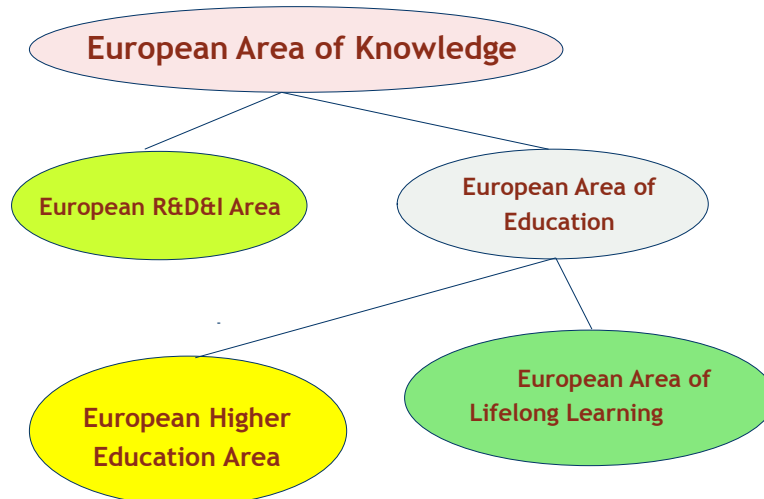
Sectoral Frameworks - Quality Assurance

- ① **A short note about Bologna... beyond Budapest-Vienna 2010**
- ② **Qualifications Frameworks**
 - ② **Meta Frameworks - QF-EHEA, EQF-LLL**
 - ② **Sectoral Frameworks - EUR-ACE**
 - ② **Descriptors at branch level - The Case Study of EFCE WP on Education**
- ③ **Quality Assurance**
 - ③ **General QA vs. Field Specific QA Models**
 - ③ **The EUR-ACE Framework Standards and Guidelines for QA**
- ④ **Concluding Notes**

The Bologna Process What needs to be understood

- ☞ Life over the past 30 years -
 - ✓ A global World living in a changing paradigm of
COOPETITION = COOPERATION + COMPETITION
- ☞ Understand the Bologna Process as one of the dimensions of the prevailing strategy for European development and adapting to this prevailing context
- ☞ We are speaking of
 - ✓ The Knowledge Society Dimension of such strategy, and
 - ✓ The creation of the European Area of Knowledge

The Bologna Process, 10 Years on... The European Area of... Knowledge... Officially launched on 11-12 March 2010, in Budapest-Vienna




Keywords characterizing the core of the Bologna reforms TRUST, MOBILITY, COOPERATION, ACCREDITATION

- ☞ The name of the game is **BUILDING TRUST**
- ☞ **TRUST GOES WITH MOBILITY, COOPERATION, ACCREDITATION**
 - ✓ **MOBILITY AND COOPERATION** require professional recognition
 - ✓ Professional recognition requires **TRUST**
 - ✓ **TRUST** requires transparency and readability of structures and professional qualifications
- ☞ All is achieved through:
 - ✓ **COMPARABLE QUALIFICATIONS FRAMEWORKS**
 - And**
 - ✓ **RECOGNISED QUALITY ASSURANCE PROCEDURES**

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Qualifications Frameworks


in *strictus sensus* and in *lactus sensus*

Sectoral Frameworks - Quality Assurance

- ☞ **Strictus sensus** a Qualifications Framework (QF) is 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.

- ☞ In **lactus sensus**, a Qualifications Framework should include (or articulate with) descriptors at lower layers:
 - ✓ Sectoral descriptors
 - ✓ Branch level descriptors

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Qualifications Frameworks

The different layers - Who does what...

Sectoral Frameworks - Quality Assurance

- ☞ **High level descriptors - Meta Frameworks**
 - ✓ Characterized at institutional level of governments and stakeholders
 - ✓ They represent the 'legal crust'

- ☞ **Complemented by Sectoral descriptors**
 - ✓ By area and specialty
 - ✓ In close cooperation with higher education institutions and professional associations
 - ✓ In transnational cooperation
 - ✓ They represent Bologna in practice

- ☞ **Complemented by descriptors at branch level**
 - ✓ Typically developed in Education Working parties and Academic Consortia, at European Level, or within regulatory bodies at national level
 - ✓ They are the basis for credibility of the whole system

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Meta Qualifications Frameworks and the Directive for Recognition of Professional Qualifications

- ☞ (Two plus One) major documents at High Level
 - ✓ The QF-EHEA -Qualifications Framework for the European Higher Education Area - An Agreement
 - Adopted in Bergen 2005, within the Bologna Process
 - ✓ The EQF-LLL - European Qualifications Framework for Lifelong Learning - A Recommendation
 - Adopted by the EC - approved on April 23, 2008 by the Parliament and the Council of the European Union
 - ✓ The Directive for Recognition of Professional Qualifications, approved by the European Parliament and by the Council on September 7, 2005 - A Law within the Union
 - National laws should have been passed in all EC Countries till the end of 2007....

QF-EHEA - Qualifications Framework for the European Higher Education Area (Bergen, 2005)

- ☞ A degree structure with three main cycles (including, within national contexts, the possibility of intermediate qualifications)
- ☞ Adopts the Dublin Descriptors developed by the Joint Quality Initiative Group as the cycle descriptors, characterizing levels to be attained in
 - *knowledge and understanding*
 - *applying knowledge and understanding*
 - *making judgements*
 - *communication*
 - *Learning skills*
- ☞ These are high level broad descriptors that will have to lead to more specific descriptors in each area or specialty within a given area

A major Legal Document - the Directive for Recognition of Professional Qualifications (I)

- ☞ Article 11 - Five levels of qualification particularly relevant for professions that are out of the Annex for fully regulated professions
 - ✓ 2 levels requiring secondary education, general or vocational
 - ✓ 1 level, requiring short post-secondary education, not necessarily at higher education level, plus professional training
 - ✓ 2 levels of post-secondary education at higher education level, plus adequate professional training

A major Legal Document - the Directive for Recognition of professional Qualifications (II)

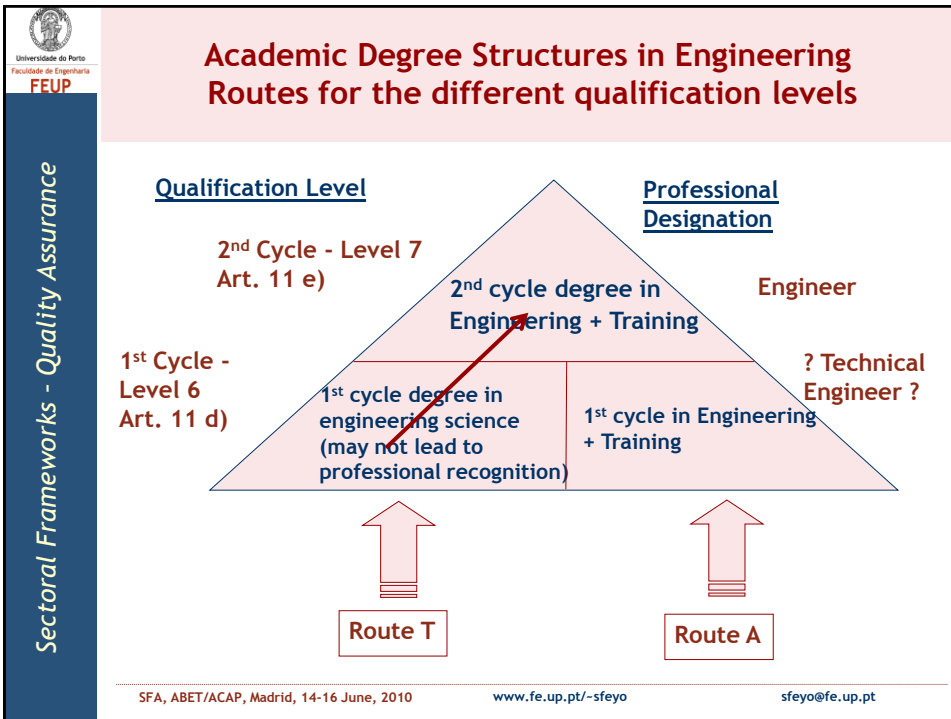
- ☞ Art. 11, e) - higher level
...completed a post-secondary course of at least four years' duration...at a university or establishment of higher education...and where appropriate completed professional training...
- ☞ Art. 11, d) - intermediate level
...training at post-secondary level of at least three and not more than four years' duration...at a university or establishment of higher education...as well as the professional training that may be required...
- ☞ Art. 11, c) - lower level
...training at post-secondary level other than that referred in d) and e) of a duration of at least one year...as well as the professional training which may be required in addition to that post-secondary course...


EQF-LLL - The European Qualifications Framework for Lifelong Learning

- ☞ Approved by the Parliament and the Council of the European Union on April 23, 2008
- ☞ Adopts 8 levels of qualifications characterized in terms of
 - Knowledge
 - Skills
 - Competences
- ☞ Establishes a link of compatibility with the Framework for Qualifications of the European Higher Education Area

Qualifications Frameworks and the Directive A striking coincidence or concerted action?

Bologna EQF-EHEA CYCLES	European Union EQF-LLL LEVELS	EU-Directive of Professional Recognition Art. 11 - LEVELS
Third Cycles	Level 8	
Second Cycles	Level 7	Art 11° e)
First Cycles	Level 6	Art. 11° d)
Short Cycles Linked to or Within First Cycles	Level 5	Art. 11° c)



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Academic Degree Structures in Engineering
Understanding fundamental differences between levels of qualifications
- Sectoral Frameworks - Quality Assurance**
- ☞ **Programme Outcomes must be evaluated in relation with the level of intervention in the Engineering Activity**
 - Social responsibility (namely, signing projects)
 - Capacity to tackle large, complex problems
 - Capacity to adapt to new jobs of high complexity and responsibility
 - Capacity for effective activity in the production line
 -
 - ☞ **For the different subsets of Programme Outcomes, and for the First and Second Cycle Degrees in Engineering, the differences in outcomes are mostly related with**
 - scope, depth and breadth
 - ☞ **For the Master degree, developing the right **ATTITUDE** to use knowledge or skills in a given situation is a major outcome**
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Relevance of Sectoral and/or Curriculum Frameworks Taken from the Leuven/Louvain-la-Neuve Communiqué 29 April 2009

“ ...
Curricular reform will thus be an ongoing process leading to high quality, flexible and more individually tailored education paths.

Academics, in close cooperation with student and employer representatives, will continue to develop learning outcomes and international reference points for a growing number of subject areas
... ”

Bringing Qualifications Frameworks into Practice Sectoral Frameworks

- ☞ TUNING Project - a methodology designed to understand curricula and to make them comparable
 - ✓ E4 proposals for Engineering
- ☞ TU3 proposals - Delft, Eindhoven e Twente
- ☞ CDIO - Conceive-Design-Implement-Operate - MIT, Swedish U.
- ☞ EUR-ACE standards for professional quality assurance
- ☞ ABET EC 2000 standards for professional quality assurance
- ☞ The TUNING-AHELO conceptual framework of expected/desired Learning Outcomes in engineering
 - ✓ A major initiative from the OECD, 2009
- ☞

The EUR-ACE Framework and Accreditation System

- ☞ European Project that aimed at establishing an European System for Qualification of Engineering Education programmes
 - ✓ 14 European Institutions, among them “Ordem dos Engenheiros - Engineers Portugal”
 - ✓ FEANI, SEFI, CESAER, EUROCADRES, ENQHEEI, ASIIN, CTI, IEI, CoPI, UNIFI, OE, UAICR, RAEE, EC-UK
- ☞ First Phase for setting the standards, supported by the European Commission (DG EaC) within SOCRATES and TEMPUS programmes; **Concluded in 2005**
- ☞ Second Phase for implementation, supported by the European Commission (DG EaC) within SOCRATES and TEMPUS programmes; **concluded in 2008**


A first note about the EUR-ACE Sectoral Framework Knowledge and Competence areas

- ☞ **Programme Outcomes that must be satisfied**
 - **6 areas of competences are defined**
 - ✓ Knowledge and Understanding
 - ✓ Engineering Analysis
 - ✓ Engineering Design
 - ✓ Investigations
 - ✓ Engineering Practice
 - ✓ Transferable (personal) Skills
 - **For each category, the EUR-ACE Framework Standards list the expected Programme Outcomes of First Cycle and Second Cycle Studies**

EUR-ACE and the META FRAMEWORKS Relating Outcomes


Table 1 - Clustering of qualifications descriptors in different frameworks

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


**Qualifications Frameworks and Quality Assurance -
What is equal, what is different
QFs, the Directive and the EUR-ACE System**

Bologna QF-EHEA CYCLES	European Union EQF-LLL LEVELS	EUR-ACE	EU-Directive of Professional Recognition Art. 11 - LEVELS
Third Cycles	Level 8		
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Descriptors at Branch/Programme Level

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- ☞ The Recommendations in the TUNING AHELO conceptual framework of expected/desired Learning Outcomes in Engineering (2009)
 - Specific LO for Civil Engineering - 1st Cycles
 - Specific LO for Electrical Engineering - 1st Cycles
 - Specific LO for Mechanical Engineering - 1st Cycles
- ☞ The Recommendations of the WPE-EFCE - Working Party on Education - European Federation of Chemical Engineering (2005, 2010)
- ☞ The VDI-GVC Recommendation for Chemical and Processing Engineering (2008)
- ☞ The CHEMPASS Project (2006-2009) - that aimed at identifying relevant general and specific Learning Outcomes for Chemical Engineering Programmes

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Descriptors at Branch/Programme Level Recommendations of the WPE-EFCE (I)

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- ☞ **WPE-EFCE - Working Party on Education - European Federation of Chemical Engineering**
 - ✓ Currently with 41 members, representing 26 Countries
 - ✓ Developed between 2003 and 2005 an exercise of identification of core curriculum for chemical engineering - contents and methodologies
 - ✓ Is currently finishing the revision of such recommendations
- ☞ See EFCE Site and Bologna Recommendations (2005) at
 - <http://www.efce.info/wpe.html>
 - http://www.efce.info/Bologna_Recommendation.html

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Descriptors at Branch/Programme Level Recommendations of the WPE-EFCE (II)

- ☞ These recommendations cover
 - Learning outcomes
 - Adopting the EUR-ACE Framework Standards for Accreditation of Engineering Education
 - Achieving the learning outcomes
 - Core curriculum
 - Teaching and learning
 - Industrial experience
 - Review of the educational process
 - Student assessment

Descriptors at Branch/Programme Level Recommendations of the WPE-EFCE (III)

- ☞ A minimum dimension is proposed for First and Second Cycles
 - ✓ Basic sciences, enlarged with life sciences
 - ✓ Chemical engineering sciences
 - ✓ Chemical engineering core
 - With engineering design
 - With a dissertation for training R&D&I
 - With diverse profiles through electives and external training
- ☞ ... Carefully keeping the field open to innovative, personalised programmes
 - The core curriculum proposed covers only approx. two thirds of a first and a second level degree study

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General Quality Assurance Approaches Main Documents and Milestones

- ☞ Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG), Bergen 2005
- ☞ The European Quality Assurance Register (EQAR), London 2007
 - Formally set on March 4, 2008
- ☞ Process led by the Council of Europe, catalysing the approval of National Qualifications Frameworks
- ☞ Creation of National Accreditation Agencies that are expected to register with EQAR

Quality Assurance in Engineering Issues leading to Field-Specific QA Systems

- ☞ Quality Assurance systems should include clear and measurable objectives and standards, associated to an accepted QF.
- ☞ The understanding by all stakeholders of academic degrees and related specific knowledge, competences and skills of their graduates is essential for both internal and external evaluation and for recognition.
- ☞ In engineering, this means that we have to develop and implement field-specific strategies and methodologies for QA that should refer to sectoral and to the respective branch specific descriptors of qualifications.

EUR-ACE Accreditation System of Engineering Education (I)

- ☞ Main documents
 - The EUR-ACE Framework Standards for the Accreditation of Engineering Programmes (approved on 5 November 2008)
 - ✓ Programme Outcomes for Accreditation
 - ✓ Criteria and Requirements for Programme Assessment and Programme Accreditation
 - ✓ Procedures for Programme Assessment and Programme Accreditation
 - The Standards and Guidelines for Accreditation Agencies
- ☞ Currently, being reviewed for convergence and substantial compatibility with ESG, INQAAHE and ECA guidelines and codes of good practice

Three indicators of relevance I - The OECD-AHELO Initiative Assessment of HE Learning Outcomes

- ☞ Report about the engineering sector published on June 23, 2009
- ☞ Proposes a set of qualifications descriptors for First Cycles that was the result of a synthesis between:
 - The ABET EC 2000 criteria
 - The EUR-ACE criteris for FIRST CYCLES
- ☞ And gives one further relevant step:
 - Proposes descriptors of 'Learning Outcomes at branch level (Civil, Electrical and Mechanical Engineering).

Three indicators of relevance II - Report on progress in quality assurance in higher education (Text with EEA Relevance), European Commission, Brussels, 21.9.2009 COM(2009) 487 final

Pg. 9:
Good practice

The EUR-ACE label in engineering exists at the bachelor and master level. Standards were defined at European level, but are applied through national quality assurance agencies that are authorised to issue EUR-ACE "labels" together with their national accreditation. Several hundred labels have already been awarded, but they are still available from only seven National agencies

Three indicators of relevance

III - Report - The EU Contribution to the European Higher Education Area, Vienna, 12.03.2010

Distributed in the Budapest-Vienna Meeting of European Ministers of Higher Education, 11-12 March, 2010

On page 8, we can read:

“The Register is open to agencies operating in Europe, be they national or international, public or private, general or subject-specific. The Commission is supporting the development of a series of subject-specific European quality labels, which could/may lend their standards to existing agencies or become agencies in their own right. Examples include the EUR-ACE label in engineering and the Eurobachelor, Euromaster and Eurodoctorate labels in chemistry.”

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EUR-ACE

Accreditation System of Engineering Education (II)

EUR-ACE Implementation

- ☞ The EUR-ACE project has led to the creation in 8 February 2006 of an European Association
 - ✓ The ENAEE - European Network for Accreditation of Engineering Education

- ☞ The ENAEE is responsible for maintaining and awarding the EUR-ACE label

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EUR-ACE - Accredited Agencies

ENAAE, proprietor of the EUR-ACE® trademark, authorizes National Agencies to award the EUR-ACE® (FC and/or SC) label

☞ As of May 2010, seven “Agencies” are authorized (EUR-ACE-accredited):

- Since November 2006 (renewed December 2008):
 - ASIIN (Accreditation Agency for Study Programs in Engineering, Informatics, Natural Sciences and Mathematics), Germany
 - CTI (Commission des Titres d’ Ingénieur), France
 - Engineers Ireland
 - RAEE (Russian Association for Engineering Education)
 - Engineering Council, United Kingdom
 - Ordem dos Engenheiros - Engineers Portugal
- Since January 2009:
 - MÜDEK (Association for Evaluation and Accreditation of Engineering Programs), Turkey

EUR-ACE - Labels awarded per Agency

As of May 2010, 600 EUR-ACE labels have been awarded

Agency	Date accr/n	Countries oper.	FCD	SCD	Total
ASIIN	Nov.2006	DE, CH	104	86	190
CTI	”	FR, BE,BG,ES	--	213	213
Eng.Ireland	”	IE	72	21	93
RAEE	”	RU, (KZ)	5	30	35
EngC	”	UK	?	?	36
OE	”	PT	0	4	4
MÜDEK	Jan.2009	TR	29	--	29

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Bologna and Routes for Professional Qualification and Transnational Cooperation (I)

- ☞ The Engineering Profession requires different qualification levels and education profiles that should be guaranteed and identified through transparent Quality Assurance Procedures
- ☞ The meta-frameworks developed within the Bologna agreements and through the initiative of the EU serve adequately the needs of industry and society in general
 - ✓ Two main levels of education (stand-alone or integrated) constitute the basis of such frameworks
- ☞ Sectoral frameworks, compatible and articulated with the meta-frameworks, are now recognized as major instruments to serve as reference for field-specific Quality Assurance systems

Bologna and Routes for Professional Qualification and Transnational Cooperation (II)

- ☞ At branch level, recommendations, descriptors, reference points and tools for characterizing degree programmes should be freely developed through institutional co-operation
- ☞ Within diversity, curricula and module syllabus should be designed with reference to such agreed recommendations or descriptors of learning outcomes at high level, sectoral level and branch level
- ☞ The aim is to increase transparency in order to
 - ✓ throw down barriers of recognition
 - ✓ promote co-operation, namely through joint degrees
 - ✓ increase mobility of students and staff

Quality Assurance in Engineering Global vs. Field Specific Systems

- ☞ The issue is not to abandon “general” QA approaches, that lead to a relevant evaluation of the educational process, but rather to understand the relevance of “field-specific” QA systems
- ☞ “Field-specific” QA systems accentuate the need for aligning the goals of educational programmes with the expectations of the relevant stakeholders, in order to be comparable and ensure their relevance for the labour market
- ☞ “Field-specific” QA systems give credibility and concreteness to the whole proposal of the European Higher Education Area.

After All... What counts...

- ☞ **Mobility is a distinctive need of Today's Global World**
- ☞ **Recognition of professional qualifications is a major task ahead...**
- ☞ **Mobility and Recognition** require transparent, compatible and **accepted** frameworks at different complementary layers, upon which **accepted** QA systems are built and applied
- ☞ **Mobility and Recognition of Qualifications are not an illusion, a dream, an objective or a target...**

They are a **MUST...**

**Required for European Development and for
Peace and Progress on Earth**