



EUR-ACE - Bringing Bologna into the Practice of Engineering Education

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Conference on Defining Quality - the relevance of field specific approaches to Quality Assurance in Higher Education

2-3 November 2009, Bonn, Germany

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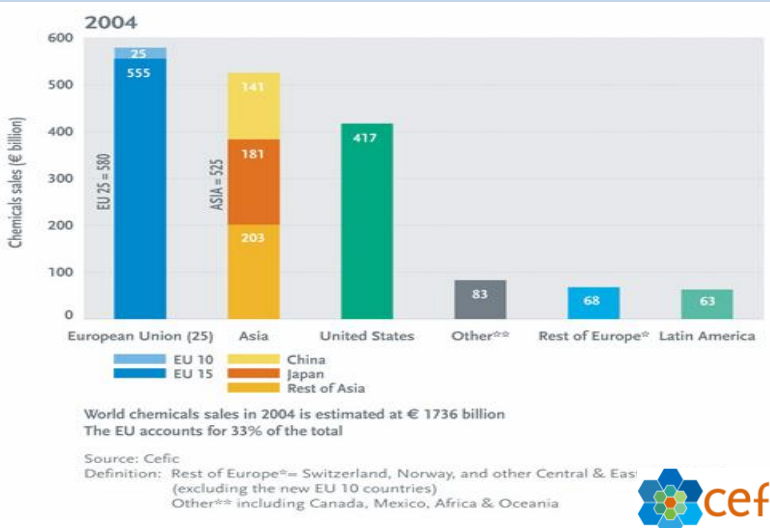


To say what I am going to say...

Sectoral Frameworks - Bologna into Practice

- ① **Bologna and today's paradigm of coexistence**
 - ① Co-operation and competition, or cooperation
- ② **Qualifications Frameworks and Qualifications Recognition**
 - ② Meta Qualifications Frameworks and Academic Degree Structures
 - ② Sectoral frameworks
 - ② Articulation between meta and sectoral frameworks
 - ② Descriptors at branch level
- ③ **Concluding Notes**

**Life Today...
Just an Example of World Competition**
Geographic breakdown of World chemicals sales, CEFIC F&F2004

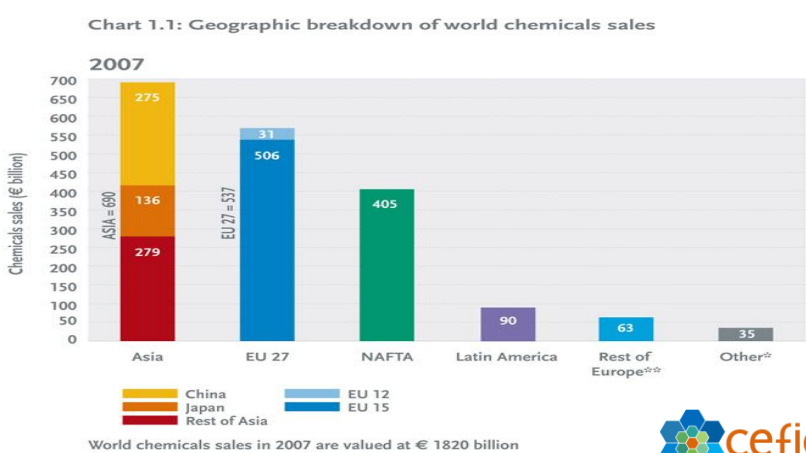


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Life over the past 30 years Driving forces for changes

- ☞ Last quarter of the 20th Century - Intense search of new routes for Europe and for the role of Europe in the World, driven by
 - ✓ Progress observed in Science and Technology, namely
 - in digital systems and communications
 - in health and life sciences
 - ✓ Political changes that took place in Europe
 - ✓ Expectations and demands of Society
 - Education for All
 - Quality requirements - The “Comfort Society”

Life Today Facts

- Economy and market forces - driving force of Today's Societies
- The computer and communications era - dramatic changes of the concepts of time and space - globalisation
- The demographic decrease and the increase of Expectation of Life - Social sustainability
- Sharp increase in standards and competition - Worldwide and within the European Space
- The need for mass education policies
- Significant change in the concepts of individual career management
- Job market and opportunities - wider than ever

Life Today A new paradigm of coexistence

- ☞ A global World living in and with a new paradigm of coexistence
 - ✓ **COOPETITION = COOPERATION + COMPETITION**
- ☞ That requires
 - New management and transnational cooperation policies
 - A new cultural paradigm of Education - Lifelong Learning
 - Mobility of students and professionals
- ☞ Which in turn requires
 - Policies and Instruments for recognition of academic and professional qualifications
 - **POLITICAL WILL**

The Bologna Process What needs to be understood

- ☞ Understand the Bologna Process as one of the dimensions of the prevailing strategy for European development - based on **KNOWLEDGE AND TRANSNATIONAL CO-OPERATION**
- ☞ Understand the Bologna Process as having two main groups of objectives, naturally interlinked
 - ✓ Objectives of political, social, and economical nature
 - ✓ Objectives of a dominant academic nature
- ☞ The Bologna Process is indeed a major dimension of the European answer to the
 - ✓ **CHALLENGES OF A CHANGING WORLD**

From Bologna to Leuven/Louvain-La-Neuve... and beyond Characterizing the Process Today

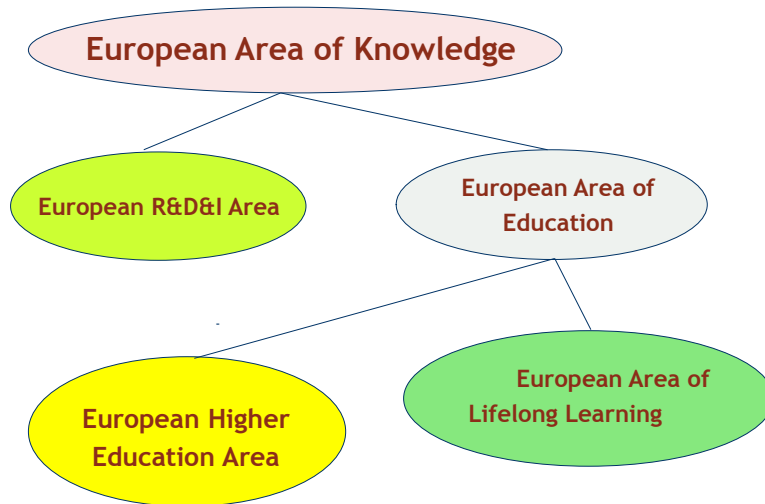
- ☞ Policy areas
- ☞ Structural organization issues
- ☞ The Substance - academic issues

From Bologna to Leuven/Louvain-La-Neuve... and beyond The Structure - action lines and instruments for action

- ✓ A Degree Structure -
 - Based on recognised QUALIFICATIONS FRAMEWORKS
- ✓ A System to measure work and OUTCOMES
 - The ECTS credit and accumulation system
- ✓ A way of documenting qualifications
 - The DIPLOMA SUPPLEMENT
- ✓ A System to guarantee transparence
 - Building accepted QUALITY ASSURANCE procedures
- ✓ A System for recognition of qualifications
 - OVERCOMING DIFFICULTIES posed by the diversity of 'recognition cultures'

The Bologna Process, 10 Years on...

The European Area of... Knowledge... still under construction till ... 2020 !!!....



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The Core of the Bologna Reforms

Keywords characterizing Structural Issues

- ☞ 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
- ☞ Such requires:
 - ✓ **COMPARABLE QUALIFICATIONS FRAMEWORKS**
 - And**
 - ✓ **RECOGNISED QUALITY ASSURANCE PROCEDURES**

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 - ② Descriptors at branch level
- ③ Concluding Notes

Qualifications Frameworks in *stritus sensus* and in *lactus sensus*

- ☞ **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.
- ☞ QF thus focus mainly on outcomes and on the several learning paths, including those of lifelong learning, that may lead to a given qualification.
- ☞ In **lactus sensus**, a Qualifications Framework should include (or articulate with) descriptors at lower layers:
 - ✓ Sectoral descriptors
 - ✓ Branch level descriptors

Qualifications Frameworks

The different layers - Who does what...

- ☞ **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....

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

- ☞ A degree structure with three main cycles and a short cycle within or linked to the First Cycle
- ☞ 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

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

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...

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)

Academic Degree Structures in Engineering Concerning levels of qualification

- ☞ **Two levels of qualifications associated to those levels approved in the Directive of Professional Recognition and recognized in the QF-EHEA and the EQF-LLL**
 - **1st Cycle, Level 6, Art. 11, d): (3-4)U**
 - ✓ **First Cycle Degrees are the basis for achieving the qualification of Technical (or Associate) Engineers, whatever the European designation**
 - **2nd Cycle, Level 7, Art. 11, e): >= 4U**
 - ✓ **Second Cycle Degrees are the basis for achieving the qualification of Engineers, or equivalent European designation**

Academic Degree Structures in Engineering Concerning Profiles

☞ Two main profiles in Engineering

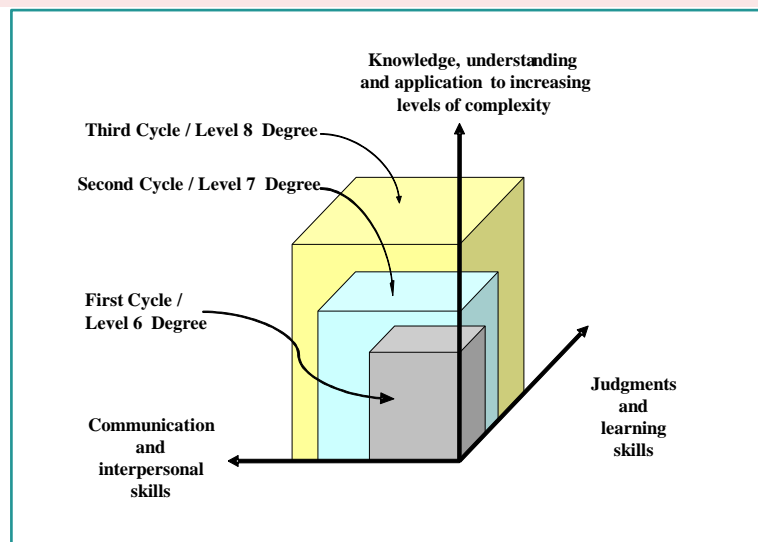
➤ More Theoretically oriented

- ✓ Programmes with a stronger emphasis on basic and engineering sciences in the first years
- ✓ Generally linked to Second Cycle degrees

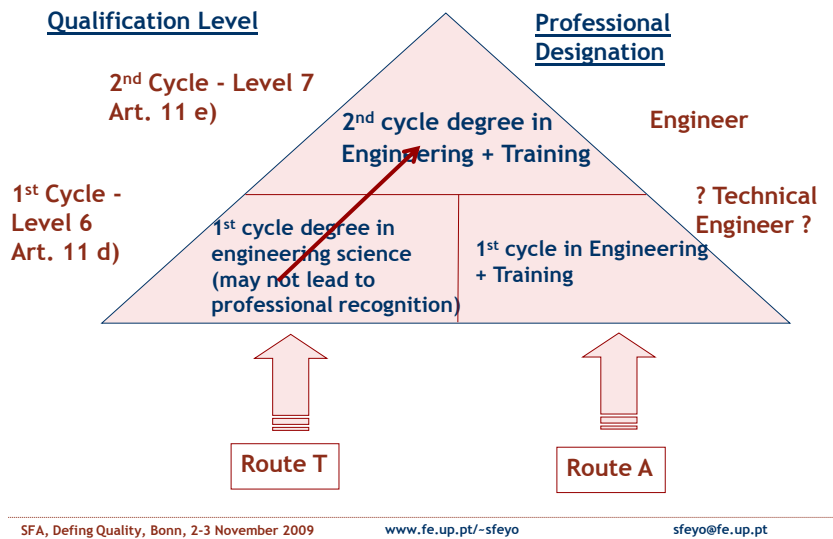
➤ More Applications oriented

- ✓ Designed to qualify after First Cycle, independently of pursuit of studies through Second Cycles, be it directly or through bridging programmes

Academic Degree Structures in Engineering Routes for the different qualification levels (I)



Academic Degree Structures in Engineering Routes for the different qualification levels (II)



Academic Degrees in Engineering Understanding fundamental differences between levels of qualifications for professional purposes

- ☞ 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 (TU3 Booklet)

To say what I am going to say...

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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
- ☞

A note about the EUR-ACE Framework Standards 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

The EUR-ACE Framework Standards Indicator of acceptance...

- ☞ Report on progress in quality assurance in higher education, from the Commission to the Council, The European Parliament, the European Economic and Social Committee and the Committee of the Regions, on 21 September 2009, p. 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

Bringing Qualifications Frameworks into Practice The OECD Initiative - AHELO - Assessment of HE Learning Outcomes

- ☞ Potentially the largest, most comprehensive assessment of universities yet devised
 - A feasibility study for assessing student Learning Outcomes
- ☞ 10 Countries involved in the start-up, on May 2008
 - Australia, Belgium (Flanders), Finland, Italy, Japan, Korea, Mexico, The Netherlands, Norway, Sweden
- ☞ Composed of four strands of work
 - Assessment of generic skills
 - Assessment of discipline - specific skills in Engineering
 - Assessment of discipline - specific skills in Economics
 - Research-based value-added strand - assessing the “value-added” factors of Higher Education Institutions

Bringing Qualifications Frameworks into Practice The TUNING-AHELO Conceptual Framework of Expected/Desired Learning Outcomes in Engineering

- ☞ Report published on 23 June 2009
- ☞ Proposes a framework of Learning Outcomes for FIRST CYCLE (BACHELOR) Degrees, that resulted from synthesizing two sets of Learning Outcomes
 - The ABET EC 2000 criteria and
 - The EUR-ACE FIRST CYCLE Learning Outcomes
- ☞ Goes one step further, proposing branch specific Learning Outcomes for a first group of three engineering branches - Civil, Electrical and Mechanical Engineering

The TUNING-AHELO proposal for Knowledge and Competence areas

- ☞ Programme Outcomes that must be satisfied
 - 5 areas of competences are defined
 - ✓ Basic and Engineering Science (EUR-ACE: Knowledge and Understanding)
 - ✓ Engineering Analysis
 - ✓ Engineering Design
 - ✓ Investigations
 - ✓ Engineering Practice
 - ✓ Transferable (personal) Skills
 - Addressing only First Cycles - a problem to overcome

EUR-ACE and the META FRAMEWORKS

I - Identification of Outcomes (I)

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

EUR-ACE and the META FRAMEWORKS

I - Identification of Outcomes (II)

Mapping of detailed descriptors

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	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	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-B. Can apply their knowledge and understanding	

EUR-ACE and the META FRAMEWORKS

II - What is equal, what is different (I)

EUR-ACE First Cycles / QF-EHEA -First Cycles / EQF-LLL- Level 6

		EUR-ACE - First Cycles																				
		I.1	I.2	I.3	I.4	II.1	II.2	II.3	III.1	III.2	IV.1	IV.2	IV.3	V.1	V.2	V.3	V.4	VI.1	VI.2	VI.3	VI.4	VI.5
QF - EHEA	FC-A	■	■	■	■																	
	FC-B					■	■	■	■	■	■	■	■	■	■	■	■					■
	FC-C						■	■	■	■	■	■	■	■				■	■	■		
	FC-D											■	■	■					■	■		
	FC-E														■	■	■	■				■
EQF-LLL	L6.1	■	■	■	■										■	■	■					
	L6.2		■	■	■	■	■	■	■	■	■	■	■	■	■	■						
	L6.3.1																	■			■	
	L6.3.2																	■		■		■

EUR-ACE and the META FRAMEWORKS

II - What is equal, what is different (II)

EUR-ACE Second Cycles / QF-EHEA -Second Cycles / EQF-LLL- Level 7

		EUR-ACE - Second Cycles																				
		I.1	I.2	II.1	II.2	II.3	II.4	III.1	III.2	III.3	IV.1	IV.2	IV.3	IV.4	V.1	V.2	V.3	VI.1	VI.2	VI.3		
QF - EHEA	SC-A	■	■															■	■			
	SC-B			■	■	■	■	■	■	■						■	■	■				
	SC-C					■	■	■	■	■	■	■	■	■					■	■	■	
	SC-D																			■	■	■
	SC-E				■							■	■	■	■							
EQF-LLL	L7.1.1	■	■																			
	L7.1.2	■	■																			
	L7.2			■	■	■	■	■	■	■	■	■	■	■	■	■						
	L7.3.1																■			■	■	
	L7.3.2																	■		■	■	■

EUR-ACE and the META FRAMEWORKS

II - What is equal, what is different (III)

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
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Descriptors at branch level The VDI-GVC Recommendation for Chemical and Processing Engineering (2008) (I)

- ☞ VDI -GVC - GesellschaftVerfahrenstechnik und Chemieingenieurwesen - (Society for Chemical and Process Engineering)
- ☞ VDI-GVC approved qualifications frameworks for degree course for Process Engineering, Chemical Engineering and Biomolecular or Bioprocess Engineering
- ☞ Recommendations cover both 'more theoretically oriented' and 'more vocationally oriented' profiles
- ☞ Recommendations apply to consecutive Bachelor's and Master's degree courses

Descriptors at branch level The VDI-GVC Recommendation for Chemical and Processing Engineering (2008) (II)

- ☞ Recommendations are structured in:
 - ✓ Professional profile and qualification framework
 - ✓ Qualifications for admission to the course
 - ✓ Structure of the degree course
 - ✓ Contents of the degree course
- ☞ The Professional profile and qualification framework is organized in the six main outcomes adopted by EUR-ACE

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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 Qualifications Frameworks and Quality Assurance Procedures
- ☞ The frameworks being developed and put in practice within the Bologna agreements seem to serve adequately the needs of industry and society in general
 - ✓ Short vocational studies, first cycle studies and second cycle studies (stand-alone or integrated) constitute the umbrella of such framework
 - ✓ This should be brought to practice through sectoral and branch level descriptors accepted by the stakeholders

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 'cultural' barriers of recognition**
 - ✓ **promote co-operation, namely through joint degrees**
 - ✓ **increase mobility of students and staff**

Bringing Bologna into Practice (I)

- ☞ **National Qualifications Frameworks are the reference**
 - ✓ **It is clear that they must be in substantial conformity with Frameworks at all levels developed within the Bologna Process or other transnational cooperation**
- ☞ **Quality Assurance procedures should**
 - ✓ **Include criteria that are in substantial conformity with those accepted descriptors at meta, sectoral and branch level**

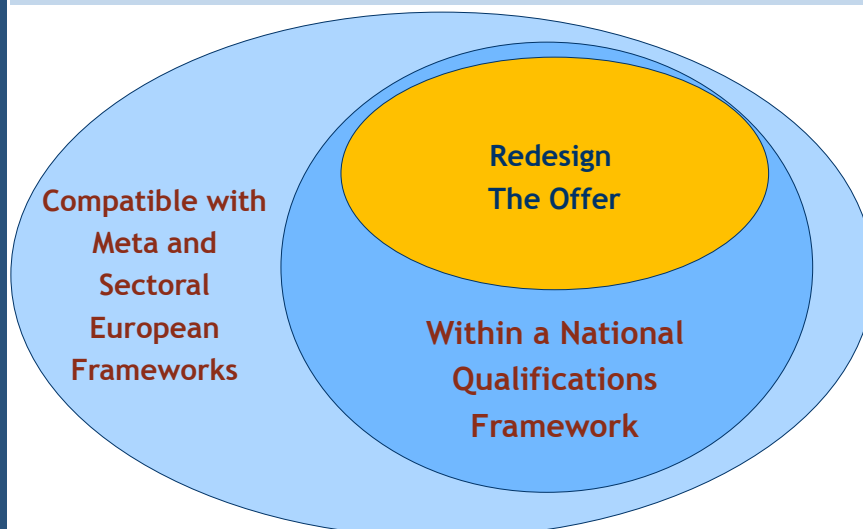
Bringing Bologna into Practice (II)

- ☞ For some countries, the most difficult bit of the Bologna Reform
 - ✓ Defining NQF compatible with existing Frameworks
 - ✓ Characterizing the programmes through ECTS - Workload plus Outcomes
 - ✓ Re-doing of all modules within this new framework
 - ✓ Giving evidence that approved Learning Outcomes are achieved

- ☞ Or simply, bringing Bologna into practice...

- ☞ A lot of work... that requires full involvement of Academics !!!

Bringing Bologna into Practice (III)



After All... What counts...

- ☞ Mobility is a distinctive need of Today's Global World
- ☞ Recognition of professional qualifications is a major task ahead...
- ☞ Qualifications Frameworks are a cornerstone of the process
- ☞ Mobility and Recognition of Qualifications are not an illusion, a dream, an objective or a target...

They are a MUST...

Required for Peace and Progress on Earth