Understand Challenges Curriculum Innovation and Accreditation Best Practices

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Curriculum Innovation and Accreditation Best Practices

To say what I am going to say…

① The need for reform and change
  ① New paradigms to meet social, cultural, scientific and technological development

② Main concepts and issues at stake
  ② Qualifications Frameworks and Quality Assurance Systems

③ New directions in Engineering Education

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Global World
A new Paradigm of Coexistence - COOPETITION

- A very fast changing World
- Progress observed in Science and Technology, namely
  - ✓ in digital systems and communications
  - ✓ in health and life sciences
- Political changes that took place in Europe in the eighties
- Expectations and demands of Society and of Today's Life
  - ✓ Education for All
  - ✓ Quality requirements and increased competitiveness
  - ✓ Need for mobility
  - ✓ Need for Lifelong Learning
- A NEW PARADIGM of COOPERATION AND COMPETITION
- RECOGNITION OF QUALIFICATIONS – A COMMON NEED

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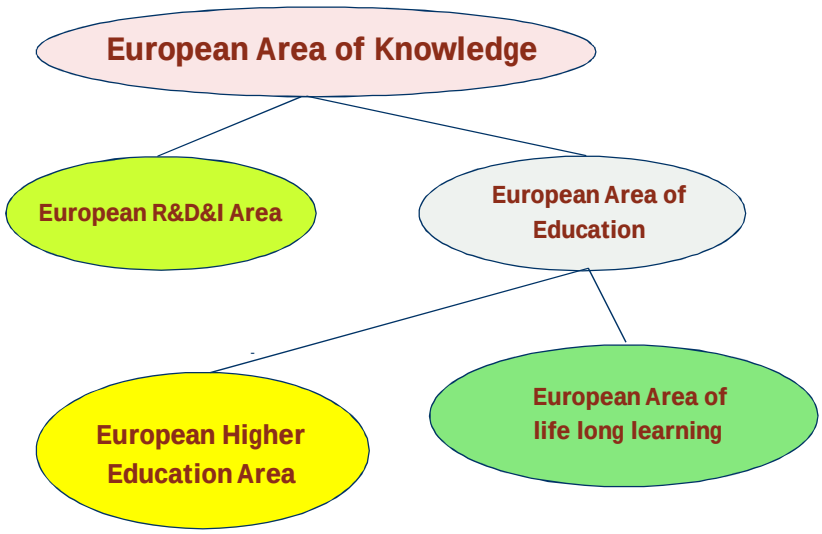
The Bologna Process
Building the European Area of Knowledge… till 2010 !!!....



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The Core of the Bologna Reforms
Structure and Substance

- The Structure – basically done
  - ✓ A Degree Structure – QUALIFICATIONS FRAMEWORKS
  - ✓ A System to measure work and OUTCOMES – ECTS
  - ✓ A System to document qualifications – DIPLOMA SUPPLEMENT
  - ✓ A System to guarantee transparence – QUALITY ASSURANCE
- The Substance – changes to a large extent still to occur
  - ✓ New contents… closer to more immediate Societal concerns
  - ✓ Teacher-Centred to Student-Centred methodologies
  - ✓ Teaching based on Teacher Inputs to Learning Centred in well defined objectives – Learning Outcomes
  - ✓ Teaching Times to Student Workloads required to achieve desired Learning Outcomes

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The Bologna Process
Keywords

- MOBILITY, COOPERATION, TRUST, 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
The different layers – Who does what…

- **High level descriptors – European Frameworks**
  - ✓ **Characterized at institutional level of governments and stakeholders**
  - ✓ **They represent the 'legal crust'**
- **Sectoral and specific (sub-sectoral) descriptors**
  - ✓ **By area and specialty**
  - ✓ **In close cooperation with higher education institutions and professional associations**
  - ✓ **In transnational cooperation**
  - ✓ **They represent Bologna in practice**
- **Curriculum descriptors – core contents**
  - ✓ **Typically developed in Education Working parties and Academic Consortiuns, at European Level, or within regulatory bodies at national level**
  - ✓ **They are the basis for credibility of the whole system**

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High Level Descriptors Qualifications Frameworks and the Directive for Recognition of Professional Qualifications

- **Three major documents at High Level**
  - ✓ **The QF-EHEA -Qualifications Framework for the European Higher Education Area**
    - **Adopted in Bergen 2005, within the Bologna Process**
  - ✓ **The EQF-LLL – European Qualifications Framework for Lifelong Learning**
    - **Adopted bt 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**
    - **National laws should have been passed in all EC Countries till the end of 2007**

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Relevance of Sectoral and/or Curriculum Frameworks Taken from the Leuven/Louvain-la-Neuve Communique 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 or Subject Specific Frameworks

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What we have…

- TUNING methodology
  - ✓ E4 proposals for Engineering
- TU3 proposals – Delft, Eindhoven e Twente
- EUR-ACE standards for professional quality assurance
- CDIO – Conceive-Design-Implement-Operate
- ABET standards for professional quality assurance
- European projects to identify core knowledge and competences at discipline level
- Initiatives leading to core curricula recommendations
  - ✓ European Working Parties on Education

Qualifications Frameworks and Quality Assurance
I - Clustering of qualifications descriptors
QF-EHEA - EQF-LLL - EUR-ACE

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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

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Qualifications Frameworks and Quality Assurance – II - 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		
Second Cycles	Level 7	Second Cycles	Art 11º e)
First Cycles	Level 6	First Cycles	Art. 11º d)
Short Cycles Linked to or Within First Cycles	Level 5		Art. 11º c)

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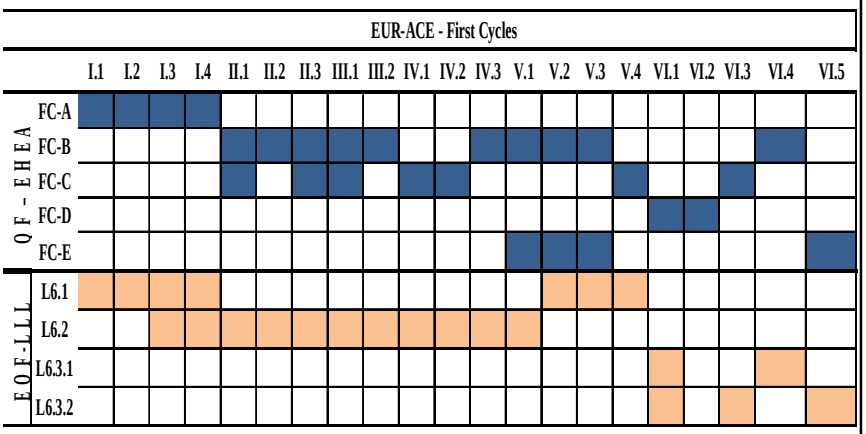
Qualifications Frameworks and Quality Assurance III - Comparing qualifications descriptors (a) - First Cycles - Level 6



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Qualifications Frameworks and Quality Assurance

III - Comparing qualifications descriptors

(b) - Second Cycles – 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																■		■	■

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Qualifications Frameworks and Quality Assurance

I - What is equal, what is different

CDIO-Dublin-EUR-ACE-ABET

Table 1 - Relation between CDIO - Dublin Descriptors - EUR-ACE Standards - ABET EC2000 accreditation requirements				Dublin - Master					EUR-ACE						ABET									
CDIO				a)	b)	c)	d)	e)	1	2	3	4	5	6	a	b	c	d	e	f	g	h	i	j	k
1	Technical knowledge and reasoning	1.1	Knowledge of underlying sciences	1					1						1									
		1.2	Core engineering fundamental knowledge	1					1						1									
		1.3	Advanced engineering fundamental knowledge	1					1															1
2	Personal and professional skills and attributes	2.1	Engineering reasoning and problem solving	1	1	1				1	1							1						
		2.2	Experimentation and knowledge discovery	1	1					1	1	1				1								
		2.3	System thinking		1					1	1	1	1											
		2.4	Personal skills and attitudes		1			1		1	1	1	1	1								1		
		2.5	Professional skills and attitudes		1	1		1				1	1	1					1					
3	Interpersonal skills: Teamwork and communication	3.1	Teamwork											1			1							
		3.2	Communications				1							1						1				
		3.3	Communications in foreign languages				1							1										
4	Conceiving, Designing, Implementing and Operating systems in the enterprise and societal context	4.1	External and societal context		1							1	1	1							1		1	
		4.2	Enterprise and business context		1							1	1	1							1			
		4.3	Conceiving and engineering systems		1												1							
		4.4	Designing		1							1					1							
		4.5	Implementing		1												1							
		4.6	Operating														1							

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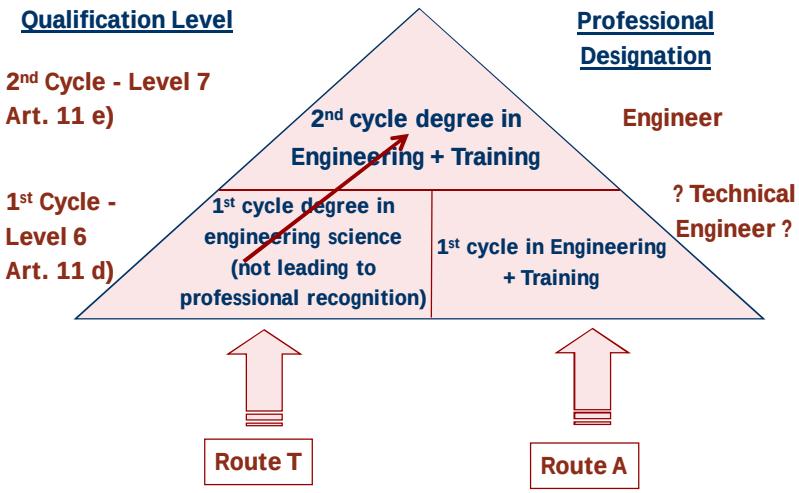
Academic Degree Structures in Engineering
Routes for the different qualification levels



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Quality Assurance in Engineering Education
Programme Outcomes for Accreditation (I)

- Quality assurance procedures rely on accepted qualifications frameworks
- Programme outcomes for accreditation should always be related to potential professional recognition of engineering qualifications

↳ As such:

- There should be only one set of programme outcomes for accreditation of Second Cycle Degrees
  - ↳ (Whatever the profile and programme)
- There should be only one set of programme outcomes for accreditation of First Cycle Degrees

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Recognition of Qualificatios – a Worldwide Issue
I - EUR-ACE vs. other existing global 'accords' [W-S-D] (I)

- ***Need to understand different levels of qualification***

- ***Different "accords":***
  - Washington Accord
  - Sydney Accord
  - Dublin Accord

- ***Different "registers":***
  - EMF International Register of Professional Engineers
  - ETMF International Register of Engineering Technologists
  - APEC Register of Professional Engineers

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Recognition of Qualifications – a Worldwide Issue
III – OECD Initiative
AHELO – Assessment of HE Learning Outcomes

- **Potentially the largest, most comprehensive assessment of universities yet devised**
  - **The aim is to measure various types of Learning Outcomes and to examine a wide range of possible criteria to assess their influence in those 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 strand 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**

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A little bit of History
Paradigm shifts in Engineering Education

- Here, I do not speak so much of changes, but rather of adapting basic assumptions
- 1st Paradigm(s) ?
  - In general terms - First quarter of the XX Century - Education close to industry and to industrial operations
- 2nd Paradigm(s) ?-
  - In general terms – Third quarter of the XX Century – Education shift to Engineering Science
- 3rd paradigm ?
  - ✓ We are at present on the process of developing a model and of conceptualizing the evolution for a new paradigm… which is not yet quite identified…

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New Directions for Engineering Education
I – Methods and contents for …

- Of course directed to technical knowledge (depending on the discipline)

BUT

- Should include developing of skills and competences valued by Industry and Society in general
  - Skills and competences for innovation and entrepeneurship
  - Job related skills
  - Teamwork, Communication, Leadership
  - Competencies (How tasks are done)
  - Take risks, grab opportunities
  - Holistic thinking, influencing, Self-management, achievement of objectives..

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New Directions for Engineering Education
III – Lifelong Learning

- Lifelong learning is the key for ensuring progress
  - ✓ It is the only way to avoid obsolescence
  - ✓ 1st degrees for sure do not cover all relevant technical topics
  - ✓ Complementary offer - formal courses, 'hands-on' and 'on-the-job' training, distance and interactive courses… obviously the Internet…
- Paradox - employers, promoting short-term jobs and forced mobility, are reluctant to educate staff - SOMETHING TO FIGHT AGAINST
  - ✓ In a number of countries there is pro-active legislation with incentives for innovation

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New Directions for Engineering Education
IV - Profiles - diversity required

- To what extent should EE approach (or combine with) immediate societal needs and concerns and industrial practice?
- Should EE rather be research oriented?
- Indeed, diversity is absolutely required
  - We should not treat as equal what is different !!!

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New Directions for Engineering Education
V - Third Paradigm? Is it so?

- If there is, it is of a different nature of the second paradigm
- Still fuzzy, can we see it?
  - Student centred learning methods
  - Skills and competencies
  - Cultural interchanges - base on transnational cooperation
  - Inducing pro-active attitude for lifelong learning as the key for individual career management
  - .....

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Inspiring words from Chemical Engineering Education
We should not forget the Sine Wave of Life

- The words of A.B. Newman, President AIChE, 1938

  'Theoretical descriptions should be limited to illustrate the engineering fundamentals, because a manager does not hire a young engineer just because he is able to describe how a product is produced'.

- Words of Ralph Landau, Stanford University, 1997*:

  'I believe chemical engineering's third paradigm, if there is one, is to return the discipline closer to the practices in industry'

* Landau, R. (1997), "Education: Moving from Chemistry to Chemical Engineering and Beyond," Chemical Engineering Progress, AIChE, pp. 52-65

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New Directions for Engineering Education
What´s the role of the Bologna Process in this search for new directions?

- Promotes an open intercultural attitude
- Promotes European cooperation
- Promotes transparent, readable curricular changes
  - ✓ Strengthening cooperation with Society – Industry, Business…
  - ✓ ……
  - ✓ Fostering innovative work
  - ✓ ……
  - ✓ Pushing academics to revisit, review and adapt contents and methods
- Full consequences are obviously yet to be evaluated !!!