



How does CHEMEPASS articulate with Meta and Sectoral Qualifications Frameworks?

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To say what I am going to say...

CHEMEPASS, Meta and Sectoral Frameworks...

- ① A short note about Bologna beyond Leuven/Louvain La Neuve
- ② Qualifications Frameworks and Qualifications Recognition
 - ② Meta Qualifications Frameworks and Academic Degree Structures
 - ② Sectoral frameworks and descriptors at branch level
- ③ Chemical Engineering Education in and for the future
 - ③ Recommendations, guidelines and transparency tools for Chemical Engineering Education
 - ③ The place of CHEMEPASS
- ④ Concluding Notes

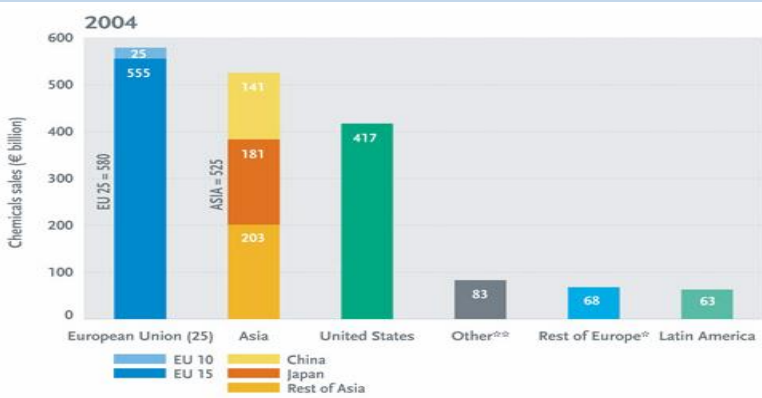
The Bologna Process, 10 Years On What it is not... What it is...

- ☞ **The Bologna Process is not...**
 - ✓ Any criticism or defeating position relatively to the past of Higher Education
 - ✓ A magic solution to improve from night to day the system of Higher Education
- ☞ **The Bologna Process is...**
 - ✓ The perception of the present and the preparation of the future in a Global World of fast and deep changes
- ☞ **The Bologna Process is indeed a major dimension of the European answer to the**
 - ✓ **CHALLENGES FOR A CHANGING WORLD**

Life Today Preparing for the Future... Essential instruments and policies

- ☞ **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**

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



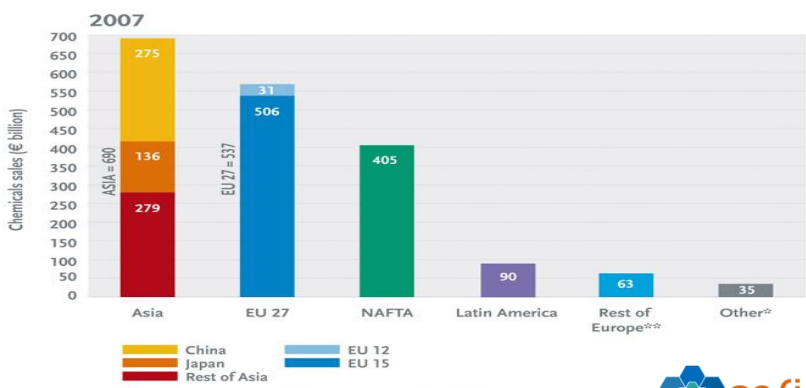
World chemicals sales in 2004 is estimated at € 1736 billion
The EU accounts for 33% of the total

Source: Cefic
Definition: Rest of Europe* = Switzerland, Norway, and other Central & East (excluding the new EU 10 countries)
Other** including Canada, Mexico, Africa & Oceania



**Life Today...
Just an Example of World Competition**
Geographic breakdown of World chemicals sales, CEFIC F&F2007

Chart 1.1: Geographic breakdown of world chemicals sales



World chemicals sales in 2007 are valued at € 1820 billion
The EU accounts for 29,5% of the total

Source: Cefic Chemdata International
Other* = Oceania and Africa
Rest of Europe** = Switzerland, Norway and other Central & Eastern Europe (excluding the new EU 12 countries)



European search for a new, more competitive, model for development, with three visible dimensions

- ☞ A strategy based on Knowledge and Transnational Cooperation, where we can recognize -
 - ✓ **The Economy Dimension -**
 - Including the movement that converged in the creation of the EURO
 - ✓ **The Social Dimension -**
 - In line with the European culture of humanism, reasoning, freedom and democracy
 - ✓ **The Knowledge Society Dimension -**
 - Identified with the Bologna Process and the creation of the **European Area of Knowledge**

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

- ☞ **Policy areas**

- ☞ **Structural organization and issues**

- ☞ **The Substance**

From Bologna to Leuven/Louvain-La-Neuve... and beyond Policy Areas - Political objectives and concerns

- ✓ Mobility
- ✓ Social dimension
- ✓ Employability
- ✓ Lifelong Learning
- ✓ Attractiveness or the Process in a global dimension

- ✓ Challenges posed by Global Competition - 'Borderless Higher Education Market'
- ✓ Need for International Cooperation - recognition
- ✓ The demographic challenge - new publics
- ✓ New leading roles and responsibilities
- ✓ Monitoring quality within diversity with multidimensional transparency tools
- ✓ Accessing diverse sources of funding

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 System to document 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'

From Bologna to Leuven/Louvain-La-Neuve... and beyond The Substance - the latecomer in the Bologna Process...

- ✓ **Changes to a large extent still to occur**
 - **New contents...** closer to more immediate Societal concerns
 - **New programme structures**, linked to a concept of lifelong Learning
 - **New Methods** - change from
 - ✓ **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

The Core of the Bologna Reforms Keywords characterizing Structural and Political Objectives

- ☞ **MOBILITY, COOPERATION, TRUST, ACCREDITATION**
 - ✓ **MOBILITY AND COOPERATION** require both academic and professional recognition
 - ✓ Academic and Professional recognition require **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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Relevant Concepts and Instruments for the changes IV - 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

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 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

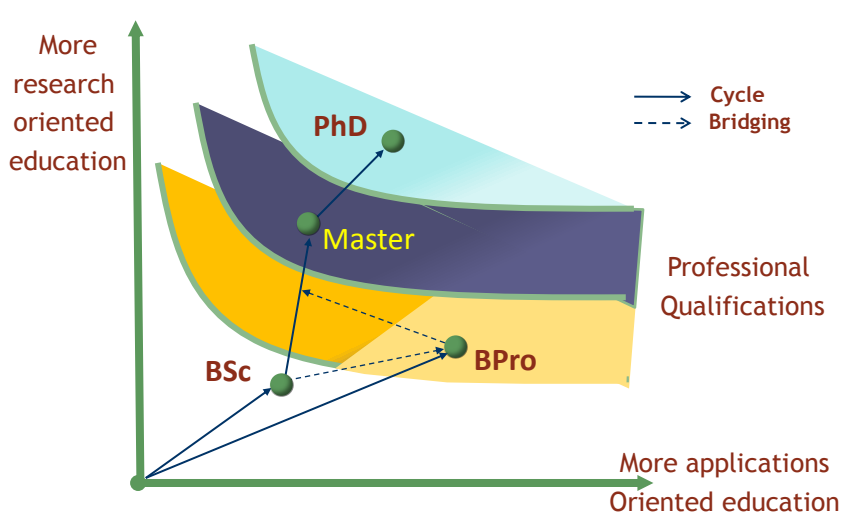
➤ More Theoretically oriented

- ✓ 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



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)

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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

What we have...

- ☞ **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

Bringing Qualifications Frameworks into Practice The EUR-ACE Project - The EUR-ACE Framework

- ☞ **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**

The EUR-ACE Framework III - 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**

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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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 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**

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

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Chemical Engineering Education in and for the future Contributions in the XXI Century

- ↪ Chemical Product Design (E. Cussler and G. Moggeridge, 2001)
- ↪ Chemical Engineering, Visions of the World (R. Darton et al., 2003)
- ↪ New Frontiers for ChE Education (R. Armstrong, 2003)
- ↪ Beyond the Molecular Frontier. Challenges for Chemistry and Chemical Engineering, US NRC Report (2003)
- ↪ The proposals of TUNING-E4 Thematic Network (2003)
- ↪ The Recommendations of WPE-EFCE (2005)
- ↪ The CHEMEPASS Project (2007-2009)
- ↪ The VDI-GVC qualifications frameworks for degree course for Process Engineering, Chemical Engineering and Biomolecular or Bioprocess Engineering (2008)

Descriptors at programme level I - Recommendations of the WPE-EFCE (I)

- ☞ **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
- ✓ See EFCE Site and Bologna Recommendations (2005) at
<http://www.efce.info/wpe.html>
http://www.efce.info/Bologna_Recommendation.html

Descriptors at programme level

I - Recommendations of the WPE-EFCE (II)

- ☞ These recommendations cover
 - Learning outcomes
 - General chemical engineering skills and knowledge
 - Transferable skills
 - Achieving the learning outcomes
 - Core curriculum
 - Teaching and learning
 - Industrial experience
 - Review of the educational process
 - Student assessment
- ☞ The core curriculum proposed covers only approx. two thirds of a first and a second level degree study

Descriptors at programme level

I - Recommendations of the WPE-EFCE (III)

- ☞ Using as reference accumulated knowledge, competences and skills after a Second Cycle in Chemical Engineering
 -
- ☞ A minimum dimension is proposed to
 - ✓ 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.

Descriptors at programme level

II - The VDI-GVC Recommendation for

Chemical and Processing Engineering (2008) (I)

- ☞ 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 programme level

II - 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

Descriptors at programme level

III - The CHEMEPASS Project (2006-2009)

☞ Milestones

- ✓ Identification of relevant general and specific Learning Outcomes for Chemical Engineering Programmes
- ✓ Identification of knowledge to be tested among Chemical Engineering core subjects
- ✓ Development of a database with test questions

☞ CHEMEPASS represents a major contribution at branch level

- ✓ In mapping curricula and characteristics of programmes offered, thus allowing for conclusions to be drawn about profiles and core contents...
- ✓ In providing tools for relative assessment of knowledge and competences....

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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 framework 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 basis of such framework
- ☞ The concept of Credit Accumulation, together with Lifelong Learning, is of utmost relevance in this new paradigm of building professional qualifications

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

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 of Qualifications are not an illusion, a dream, an objective or a target...**

They are a MUST...

Required for Peace and Progress on Earth