Comments on EQF and NQF
Role in the Bologna Process
Levels and Descriptors
CDIO and its relation with other descriptors

Sebastião Feyo de Azevedo
Department of Chemical Engineering, Faculty of Engineering,
University of Porto, Portugal
Ordem dos Engenheiros - Engineers Portugal
sfayo@fe.up.pt
http://www.fe.up.pt/~sfayo

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The Bologna Process
The Academic Revolution - What we want

- 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
The Bologna Process
The Academic Revolution -
Mechanisms for inducing changes

- Main concepts for promoting changes
  - A Credit System based on Learning Outcomes and on the required Workload
    - If well defined, they will have clear influence on learning methods
- A clear National Qualifications Framework
  - Including descriptors at the required differentiated levels
- A Quality Assurance System with criteria that are taken from the NQF
- We should understand the complementarity of concepts and mechanisms in discussion

Qualifications Framework
Requirements for definition

- A conceptual framework should define/identify (TU-3 proposals)
  - A system of competences
  - Ways of characterizing those competences
    - Academic Dimensions
  - A system of grading the academic dimensions
- We should understand that a complete QF may involve up to 4 levels of descriptors
- For the Engineering Sector there are several proposals for
  - System / Type of Competences
  - Dimensions
  - Grading Scales
Qualifications Framework

Example of levels for descriptor - Engineering

- Dublin Descriptors - High Level Descriptors
  - Characterize high level groups of competences
  - Note the link with the Directive for Professional Recognition

- Sectoral Descriptors
  - Ideally resulting from wide transnational agreements
  - EUR-ACE, CDIO...

- Specific Descriptors
  - For each engineering discipline
  - Including the identification of professional activities for which the candidates are to be prepared

- Contents - core curricula
  - LEARNING OUTCOMES ARE THE REFERENCE, BUT
  - They must earn the trust of society through the specialists opinion
    - Contents and workload

Qualifications Frameworks

What is available

- EQF - EHEA, based on Dublin Descriptors
- EQF - LLL
- TUNING methodology
- E4 proposals for Engineering
- TU3 proposals - Delft, Eindhoven e Twente
- CDIO - Conceive-Design-Implement-Operate
- EUR-ACE for professional quality assurance
- ABET Framework
- Specific descriptors - Core curricula - European Working Parties on Education
European Qualifications Frameworks
The difficult bits

- Still fuzzy the relation Workload - Outcomes
  - New guidelines for ECTS are about to be proposed

- There are still difficulties in interpreting EQF and in developing and applying related accreditation criteria, especially in the comparative distinction between FCD (Bachelor) and SCD (Master) programmes.
  - The EQF and the Professional Directive 2005/36 are by no means clear in this respect.

- Overcoming these difficulties will be a fundamental test for the validity and applicability of the EQF

Quality Assurance
The EUR-ACE Project

- The Standards developed:
  - Specify the Programme Outcomes that must be satisfied
  - Accredit programmes, not of Departments or Universities
  - Accredit education, not of whole formation
  - Are valid for all branches of engineering and all profiles
  - Distinguish between First and Second Cycle programmes, as defined in the European Qualification Framework
  - Are applicable also to “integrated programmes”, i.e. programmes that lead directly to a Second Cycle degree
  - Describe what is to be achieved but not how, and as such
    - Can accommodate national differences of educational and accreditation practice
Quality Assurance
The EUR-ACE Project

- Programme Outcomes that must be satisfied
- 6 categories of learning outcomes 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

Quality Assurance
The EUR-ACE Project and ENAEE

- ENAEE was born on February 8, 2006, with Founding Members:
  - FEANI (acting Secretariat)  RAEE (RU)
  - SEFI  CoPI (IT)
  - UNIFI/TREE  IEI-Engineers Ireland
  - EUROCADRES  OE (Ordem…) (PT)
  - EC (UK)  UAIER (RO)
  - CTI (FR)  IDA (DK)
  - ASIIN (DE)  FOTEP/BBT (CH)
- New Members (admitted at the Second General Assembly, 17 November 2006)
  - CLAIU  MÜDEK
Quality Assurance
The EUR-ACE Project and ENAAEE

The EUR-ACE system is now being implemented by six Agencies, that will form its initial “core”:

- ASIN (DE)
- EC (UK)
- IEI-EngineersIreland
- CTI (FR)
- OE (PT)
- RAEE (RU)

The representatives of these Agencies sit in the EUR-ACE Label Committee

Quality Assurance
The ABET System -
ABET 07-08 Criterion 3 - Outcomes and Assessment

a. An ability to apply knowledge of mathematics, science, and engineering.
b. An ability to design and conduct experiments, as well as to analyse and interpret data.
c. An ability to design a system, component, or process to meet desired needs.d. An ability to function on multi-disciplinary teams.
e. An ability to identify, formulate, and solve engineering problems.
f. An understanding of professional and ethical responsibility.
g. An ability to communicate effectively.
h. The broad education necessary to understand the impact of engineering solutions in a global and societal context.
i. A recognition of the need for, and an ability to engage in lifelong learning.
j. A knowledge of contemporary issues.
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
Quality Assurance
EUR-ACE vs. other existing global ‘accords’ [W-S-D]

**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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Quality Assurance
EUR-ACE vs. other existing global ‘accords’ [W-S-D] (II)

**Fundamental differentiation/barrier between**
- “Professional Engineers” and
- “Engineering Technologist”

**Define all recognized (accredited) “Engineers’ ” degrees as “Bachelor”**.

**These features are not in the spirit of the EQF nor of EU Directive 2005/36**

**Indeed some discussion is currently on the air, concerning recognition of standards**
## Quality Assurance and Qualifications Frameworks

### 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

<table>
<thead>
<tr>
<th>CDIO</th>
<th>Dublin - Master</th>
<th>EUR-ACE</th>
<th>ABET</th>
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</thead>
<tbody>
<tr>
<td>Technical knowledge and reasoning</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1. Knowledge of underlying sciences</td>
<td>1</td>
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<tr>
<td>2. Core engineering fundamental knowledge</td>
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<tr>
<td>3. Advanced engineering fundamental knowledge</td>
<td>1</td>
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<td>4. Engineering reasoning and problem solving</td>
<td>1</td>
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<td>5. Systemization and knowledge discovery</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>6. Creativity and innovation</td>
<td>1</td>
<td>1</td>
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<tr>
<td>7. Professional skills and attributes</td>
<td>1</td>
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<tr>
<td>8. Personal and professional skills and attributes</td>
<td>1</td>
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<tr>
<td>9. Interpersonal skills: Teamwork</td>
<td>1</td>
<td>1</td>
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<tr>
<td>10. Communication</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>11. Communication in foreign languages</td>
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<tr>
<td>12. External and societal context</td>
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<tr>
<td>13. Enterprise and business context</td>
<td>1</td>
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<tr>
<td>14. Concerning and engineering systems</td>
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<tr>
<td>15. Designing</td>
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<tr>
<td>16. Implementing</td>
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<tr>
<td>17. Operating</td>
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</tbody>
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### Quality Assurance and Qualifications Frameworks

### What is equal, what is different: CDIO-Dublin-EUR-ACE-ABET

#### Dublin Descriptors - Master Level

1. Have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with Bachelor’s level, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;

2. 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;

3. Have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;

4. Can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;

5. Have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
## Quality Assurance and Qualifications Frameworks

### What is equal, what is different: CDIO-Dublin-EUR-ACE-ABET

#### EUR-ACE “Outcomes” for accreditation - Master level

1. **Knowledge and Understanding** - An in-depth knowledge and understanding of the principles of their branch of engineering; a critical awareness of the forefront of their branch.

2. **Engineering Analysis** - The ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications; the ability to formulate and solve problems in new and emerging areas of their specialisation; the ability to use their knowledge and understanding to conceptualise engineering models, systems and processes; the ability to apply innovative methods in problem solving.

3. **Engineering Design** - An ability to use their knowledge and understanding to design solutions to unfamiliar problems, possibly involving other disciplines; an ability to use creativity to develop new and original ideas and methods; an ability to use their engineering judgement to work with complexity, technical uncertainty and incomplete information.

4. **Investigations** - The ability to identify, locate and obtain required data; the ability to design and conduct analytic, modelling and experimental investigations; the ability to critically evaluate data and draw conclusions; the ability to investigate the application of new and emerging technologies in their branch of engineering.

5. **Engineering Practice** - The ability to integrate knowledge from different branches, and handle complexity; a comprehensive understanding of applicable techniques and methods, and of their limitations; a knowledge of the non-technical implications of engineering practice.

6. **Transferable Skills** - Fulfil all the Transferable-Skill requirements of a First Cycle graduate at the more demanding level of Second Cycle; function effectively as leader of a team that may be composed of different disciplines and levels; work and communicate effectively in national and international contexts.

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#### ABET (Accreditation Board for Engineering and Technology) EC2000 accreditation requirements, Criterion 3

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
- An ability to design a system, component, or process to meet desired needs.
- An ability to function on multi-disciplinary teams.
- An ability to identify, formulate, and solve engineering problems.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global and societal context.
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