A pedestrian view of the EUR-ACE® Framework Standards and Guidelines (EAFSG) for engineering education

Brussels, May 2015
An engineer is a professional practitioner who, using appropriate materials, designs components, processes, structures, and systems, while considering the limitations imposed by practicality, regulation, safety, and cost. The word engineer is derived from the Latin words *ingeniare* ("to contrive, devise") and *ingenium* ("cleverness“) [Wikipedia](https://en.wikipedia.org/wiki/Engineer).

An engineering degree is an advanced academic qualification that is conferred in universities and other higher education institutions throughout the world.
A wide diversity of professional status and regulation – the process through which an engineer becomes authorized to practise engineering and/or provide engineering professional services to the public – applies in many different countries. Wikipedia

A wide diversity of educational systems: the «engineering degree» may exist or not, and may be regulated or not,

BUT

“In OECD countries and throughout the world, there is a great degree of consensus concerning what an engineer is supposed to know and be able to do.” (Tuning-AHELO report)
A worldwide convergence

- What an engineering graduate is supposed to know and be able to do,
  - Programme outcomes

- Requirements and goals for the educational system to provide engineering graduates with the expected outcomes,
  - Quality Assurance for the programme providers and for the accreditation agencies
Two global overarching frameworks

International Engineering Alliance
• The Washington accord (1989-Engineers)
• The Sydney accord (2001-Engineering Technologists)
• The Dublin Accord (2002-Engineering Technicians)

The European Network for Accreditation of Engineering Education (2006-ENAE) with the EUR-ACE Accord (2014):
• EUR-ACE label for the Bachelor degree
• EUR-ACE label for the Master degree
The EUR-ACE® label, listed by the European Commission among the “European Quality Labels”, guarantees the quality of an engineering degree programme and its suitability as an entry route to the engineering profession (pre-professional accreditation)

While at the same time assuring:
- scientific and academic quality
- relevance for the “engineering” job
The EUR-ACE system for programmes

The 2 pillars of the EUR-ACE «wisdom»

Programme outcomes
describe the
knowledge, understanding, skills and abilities

which
an accredited engineering degree programme must enable a graduate to demonstrate.

Programme management
The programmes seeking the label should demonstrate that they are managed according to quality assurance principles (ESG, Bologna process)
The EUR-ACE system for programmes
Main references (www.enaee.eu)

Programme Outcomes

“EUR-ACE Framework Standards and Guidelines” (EAFSG)
Revised version (March 31, 2015)

Programme Management

EAFSG (March 31, 2015)
«Best practice in Accreditation of Engineering Programmes»
Joint document IEA/ENAAE (June 2015)

Programme outcomes for Engineering Education

Expected and achieved Programme Outcomes for Bachelor and Master Degree Programmes

Quality Assurance

• Programme Management
• Accreditation Agencies (accreditation criteria and processes)
EUR-ACE® Framework Standards and Guidelines

- Student Workload Requirements
- Programme Outcomes Framework
- Programme Management
- Standards and Guidelines for accreditation agencies
EUR-ACE® Framework Standards and Guidelines

• Student Workload Requirements
  • Programme Outcomes Framework
  • Programme Management
• Standards and Guidelines for accreditation agencies
Student Workload Requirements

• Compliant with the Bologna process.

• Bachelor Degree programmes, of a minimum of 180 ECTS credits.

• Master Degree programmes, of a minimum of 90 ECTS credits (60 in some educational systems).

• Master Degree programmes which are integrated – and which, normally, do not include the award of a Bachelor Degree-ECTS credits consistent with the above: i.e. a minimum of 270 ECTS credits (240 in some education systems).
EUR-ACE® Framework Standards and Guidelines

- Student Workload Requirements
- Programme Outcomes Framework
- Programme Management
- Standards and Guidelines for accreditation agencies
Programme Outcomes Framework (1)

Learning outcomes are statements of what the individual knows, understands and is able to do on completion of a learning process.

• The achievement of learning outcomes has to be assessed through procedures based on clear and transparent criteria.

• Learning outcomes are attributed to individual educational components and to programmes at a whole.

• They are also used in European and national qualifications frameworks to describe the level of the individual qualification.

Programme Outcomes Framework (2)

Sum of Learning Outcomes for all modules

Programme Outcomes
Programme Outcomes Framework (3)

Learning Outcomes vs. Programme Outcomes

Example for a Module Engineering Mechanics 2

• Apply equations for straight-line motion to solve problems with variable acceleration.

• Solve plane curvilinear motion problems in three different coordinate systems.

• Analyse dynamic problems using work/energy and impulse/momentum techniques.

Example “Engineering practice”

Graduates should be able to demonstrate,

• comprehensive understanding of applicable techniques and methods of analysis, design and investigation and of their limitations;

• practical skills, including the use of computer tools, for solving complex problems, realising complex engineering design, designing and conducting complex investigations;

• ...
Programme Outcomes Framework (4)

Eight domains of programme outcomes for engineering graduates

- Knowledge and Understanding
- Engineering Analysis
- Engineering Design
- Investigations
- Engineering Practice
- Making Judgement
- Communication and Team-working
- Lifelong Learning
Programme Outcomes Framework (5)

Example: Bachelor Degree Programme

Knowledge and Understanding
The learning process should enable Bachelor Degree graduates to demonstrate:

• knowledge and understanding of the mathematics and sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes;

• knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme outcomes, including some awareness at their forefront;

• awareness of the wider multidisciplinary context of engineering.
Programme Outcomes Framework (6)

Example: Master Degree Programme

Knowledge and Understanding

The learning process should enable Master Degree graduates to demonstrate:

• in-depth knowledge and understanding of mathematics and sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes;

• in-depth knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme outcomes;

• critical awareness of the forefront of their specialisation;

• critical awareness of the wider multidisciplinary context of engineering and of knowledge issues at the interface between different fields.
EUR-ACE® Framework Standards and Guidelines

- Student Workload Requirements
- Programme Outcomes Framework
- Programme Management
- Standards and Guidelines for accreditation agencies
Programme Management (1)

- Programme Aims
- Teaching and Learning Process
- Resources
- Student Admission, Transfer, Progression and Graduation
- Internal Quality Assurance
Programme Management (2)

Programme aims

• The aims of accredited programmes must reflect the needs of employers and other stakeholders. The programme outcomes must be demonstrably consistent with the aims.

Teaching and learning process

• The teaching and learning process must enable engineering graduates to demonstrate the knowledge, understanding, skills and abilities specified in the Programme Outcomes. The programme curriculum must specify how this is to be achieved.
Programme Management (3)

Resources
• The resources to deliver the programme must be sufficient to enable the students to demonstrate the knowledge, understanding, skills and abilities specified in the Programme Outcomes

Student Admission, Transfer, Progression and Graduation
• The criteria for student admission, transfer, progression and graduation must be clearly specified and published, and the results monitored.
Programme Management (4)

Quality Assurance

• Engineering degree programmes must be supported by effective quality assurance policies and procedures.
EUR-ACE® Framework Standards and Guidelines

- Student Workload Requirements
- Programme Outcomes Framework
- Programme Management
- Standards and Guidelines for accreditation agencies
Standards and Guidelines for accreditation agencies (1)

Programme Evaluation and Accreditation
- Methods and Procedures
- Documentation
- Accreditation Process
- Decision-making
- Publication

Quality Assurance of Accreditation Agency
- Administration
- Status and Resources
Standards and Guidelines for accreditation agencies (2)

Programme Evaluation and Accreditation

• The **methods and procedures** of the agency must ensure that engineering degree programmes are accredited accurately in accordance with the agency’s established standards.

• **Documentation**: The accreditation standards and procedures must be publicly available in an accessible format.
Standards and Guidelines for accreditation agencies (3)

Programme Evaluation and Accreditation (continued)

• The accreditation process must be effective in acquiring all the evidence necessary to make decisions.

• Accreditation decisions must be demonstrably accurate, consistent and unbiased.

• The agency must publish the outcome of the accreditation evaluation.
Standards and Guidelines for accreditation agencies (4)

Quality Assurance of Accreditation Agency

- **Administration**: The management, organisation and administration of the agency must ensure that the accreditation functions of the agency are implemented accurately and reliably.

- **Status and resources**: The agency must be independent of outside influences and have adequate resources to undertake accreditation.
ENAEE authorises accreditation agencies to award the EUR-ACE® Label to engineering degree programmes they accredit, at Bachelor and Master degree level.
## List of Authorised Agencies (May 2015)

<table>
<thead>
<tr>
<th>Country</th>
<th>Agency</th>
<th>Website</th>
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<tbody>
<tr>
<td>GERMANY</td>
<td>ASIIN – Fachakkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften, und der Mathematik e.V. - <a href="http://www.asiin.de">www.asiin.de</a></td>
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<tr>
<td>IRELAND</td>
<td>Engineers Ireland – <a href="http://www.engineersireland.ie">www.engineersireland.ie</a></td>
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<tr>
<td>ITALY</td>
<td>QUACING – Agenzia per la Certificazione di Qualità e l’ Accreditamento EUR-ACE dei Corsi di Studio in Ingegneria – <a href="http://www.quacing.it">www.quacing.it</a></td>
<td></td>
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<tr>
<td>PORTUGAL</td>
<td>Ordem dos Engenheiros – <a href="http://www.ordemengenheiros.pt">www.ordemengenheiros.pt</a></td>
<td></td>
</tr>
<tr>
<td>RUSSIA</td>
<td>AEER – Association for Engineering Education in Russia - <a href="http://www.aeer.ru">www.aeer.ru</a></td>
<td></td>
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<tr>
<td>ROMANIA</td>
<td>ARACIS – The Romanian Agency for Quality Assurance in Higher Education <a href="http://www.aracis.ro">www.aracis.ro</a></td>
<td></td>
</tr>
<tr>
<td>TURKEY</td>
<td>MÜDEK – Association for Evaluation and Accreditation of Engineering Programmes <a href="http://www.mudek.tr">www.mudek.tr</a></td>
<td></td>
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<tr>
<td>SWITZERLAND</td>
<td>OAQ - Swiss Center of Accreditation and Quality Assurance in Higher Education <a href="http://www.oaq.ch">www.oaq.ch</a></td>
<td></td>
</tr>
<tr>
<td>SPAIN</td>
<td>ANECA – Agencia Nacional de Evaluación de la Calidad y Acreditación, <a href="http://www.aneca.es">www.aneca.es</a> jointly with IIE – Instituto de la Ingeniería de España; <a href="http://www.iiies.es">www.iiies.es</a></td>
<td></td>
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</tbody>
</table>
EUROPE AND THE EUR-ACE SYSTEM

Countries (yellow) with authorised accreditation agencies
Members of ENAEE

ENAEE has currently 17 full members and 3 associate members, including Engineering Organizations, Accreditation Agencies and others

Full members

FEANI – Belgium - http://www.feani.org
ENGINEERING COUNCIL – United Kingdom - http://www.engc.org.uk
ORDEM DOS ENGENHEIROS – Portugal - http://www.ordemdosengenheiros.pt
CoPI – Conferenza dei Presidi delle Facolta’ di Ingegneria Italiane – Italy - http://www.confpresing.it
ENGINEERS IRELAND – Ireland - http://www.engineersireland.ie
AEER – Association for Engineering Education in Russia - Russia - http://aeer.ru/en
EUROCADRES – Conseil des Cadres Européens - Belgium - http://www.eurocadres.eu
UNIFI – Scuola di Ingegneria dell’Università degli Studi di Firenze - Italy - http://www.unifi.it
IDA – The Danish Society of Engineers - Denmark - http://www.ida.dk
BBT – Switzerland - http://www.bbt.admin.ch
MÜDEK – Association for Evaluation and Accreditation of Engineering Programs - Turkey - http://www.mudek.org.tr
IIIE – Instituto de la Ingeniería de España - Spain - http://www.iiies.es
TEK – Finnish Association of Graduate Engineers - Finland - http://www.tek.fi
QUACING – Italy - http://www.quacing.it

Associate Members

CLAIU – Belgium - http://www.claiu.org
IGIP – International Society for Engineering Education – Austria - http://www.igip.org
Thank you for your attention

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