



Qualifications Frameworks and Quality Assurance in Engineering - The EUR-ACE Quality System in Portugal

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To say what I am going to say...

- ① Mission of Ordem dos Engenheiros - Engineers Portugal
- ② Life Today - The European Model for Development and the Bologna Process
- ③ Some Key Issues of the Bologna Process
 - ③ European Qualifications Frameworks and the Directive for Professional Recognition; Quality Assurance
- ④ A Note about the Degree System and offer of Education in Portugal
- ⑤ EUR-ACE and the Qualification System of Engineers Portugal
 - ⑤ Framework; OE's procedure and its conformity with EUR-ACE
- ⑥ Concluding Notes



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To say what I am going to say...

- ① **Mission of Ordem dos Engenheiros - Engineers Portugal**
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Ordem dos Engenheiros - Engineers Portugal


I - Legal Framework and Mission Statement (I)

- ☞ **Engineers Portugal** is the public association that represents the holders of a BOLOGNA *SECOND CYCLE* diploma OR EQUIVALENT that work as *Engenheiros* (Engineers).
- ☞ The main purpose of the Engineers Portugal is to contribute to the development of the Portuguese Engineering by working with other partners for the improvement of legal frameworks and of the scientific, professional and social level of its members, and by accomplishing codes of professional ethics.

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Ordem dos Engenheiros - Engineers Portugal

I - Legal Framework and Mission Statement (II)

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☞ **Some competencies:**

- ✓
- ✓ To improve Engineers' professional qualification and to ensure the accomplishment of the professional code of ethics
- ✓ To support and cooperate on the development of Engineering education in order to guarantee a high standard of the Engineering profession
- ✓


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Ordem dos Engenheiros - Engineers Portugal

I - Legal Framework and Mission Statement (III)


EUR-ACE in Portugal ...

- ☞ Engineers Portugal (OE) was created in November 24, 1936 and is ruled by the Portuguese law, decree n. 119/92 of the 30th June, which contains all its legal competencies.
- ☞ Engineers Portugal is independent from the State and has administrative, financial, scientific, disciplinary and regulatory autonomy.
- ☞ Engineers Portugal is the single largest Portuguese professional association -
 - ✓ 42.480 members on 31 December 2007

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Ordem dos Engenheiros - Engineers Portugal

Membership - Numbers

EUR-ACE in Portugal ...

☛ On December 31, 2007 - 36.282 members in the 12 Specialties

✓ Civil Engineering	15.613	43,0 %
✓ Electrical Engineering	7.540	20,8 %
✓ Mechanical Engineering	4.968	13,7 %
✓ Agricultural Engineering	2.697	7,4 %
✓ Chemical Engineering	2.569	7,1 %
✓ Geological and Mining Engineering	760	2,1 %
✓ Forest Engineering	444	1,2 %
✓ Informatics Engineering	341	0,9 %
✓ Geographic Engineering	303	0,8 %
✓ Metallurgical and Materials Engineering	286	0,8 %
✓ Naval Engineering	110	0,3 %

☛ 6.198 registered trainees

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Professional Titles and Professional Regulation in Portugal

EUR-ACE in Portugal ...

☛ Professional Titles are legally protected in Portugal:

- ✓ The professional title of *Engenheiro* (Engineer) is awarded by the Engineers Portugal. All holders of a *Second Cycle Degree in Engineering* may apply for the professional title of Engineer.
- ✓ The professional title of “Engenheiro Técnico” (Technical Engineer) is awarded to any holder of a *First Cycle in Engineering* by ANET (Associação Nacional dos Engenheiros Técnicos - National Association of Technical Engineers)


☛ The Engineering Profession is partially regulated in Portugal

- ✓ Some activity, namely in Civil Engineering, but also in areas of Electrical and Mechanical Engineering, can only be performed by members of Engineers Portugal

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Institutional Co-operation and Agreements

- ☞ OE has (or has had) also several partnerships or memorandums of understanding with other European and American Engineering Association (EC-UK, ASIIN, CTI, CoPi, SEFI, IEI, RAEE, EUROCADRES, UNIFI, ABET...).
- ☞ OE further has a close relationship with similar Associations of the CPLP (Portuguese Speaking Community):
 - ✓ CONFEA - Brazil
 - ✓ Order of Engineers of Angola
 - ✓ Order of Engineers of Mozambique
 - ✓ Order of Engineers of Cabo Verde

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The Quality Assurance System of *Ordem dos Engenheiros*


Past Experience - Conceptual Model

- ☞ OE implements Quality Assurance Procedures for Engineering Degrees since 1994
- ☞ Inspired on ABET and EC-UK criteria of the nineties... with the following main reference terms
 - School Administration
 - Teaching staff
 - Curricular content
 - School enrolment and assessment of students
 - Course structure
 - R&D quality
 - Facilities and resources
 - Administrative procedures
 - Institutional culture
- ☞ Between 1994 -2007 more than 200 course evaluations


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European Strategy for Development A New Model... Lisbon Strategy for Growth and Jobs


☞ European Council of Heads of State and Governments, March 2000, Lisbon

- ✓ The Lisbon Strategy for Growth and Jobs
- ✓ Competitive positioning relatively to the other blocks of the Planet
- ✓ Stating a strategic objective:

“By 2010, making Europe the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion” .

☞ Is being pursued with the Lisbon Treaty, 2007.....

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European Strategy for Development

The three dimensions of the Strategy

☞ 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 Higher Education Area

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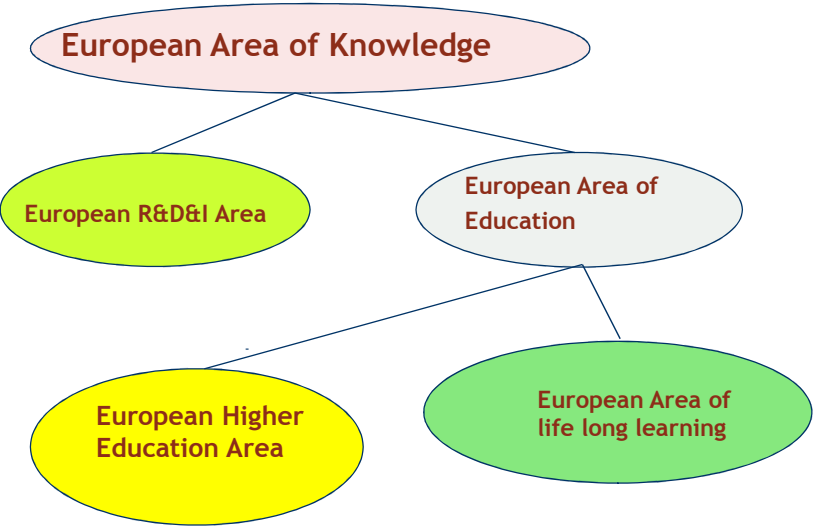


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The Bologna Process Revisited

Building the European Area of Knowledge... till 2010 !!!



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graph TD
    EAK([European Area of Knowledge]) --> ERD([European R&D&I Area])
    EAK --> EAE([European Area of Education])
    EAE --> EHEA([European Higher Education Area])
    EAE --> EALL([European Area of life long learning])
            
```

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From Bologna ... to London... and beyond...

Key Issues expressed in the London Communiqué (I)

☞ **Mobility** - a central issue, far from a success...

☞ **National Qualifications Frameworks**

- ✓ Compatible with European Frameworks
- ✓ Necessarily compatible with the European Directive on Recognition of Professional Qualifications
- ✓ Compatible with Sectoral frameworks approved at European level
- ✓ Fine tuned at Specialty or Discipline level
- ✓ The CONTENTS level - How relevant?

☞ **Quality Assurance - The European Register**

- ✓ Should care for recognised procedures at European Level


☞ **Social issues** - Employability, social dimension...

☞ **Global dimension** - Attractiveness


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From Bologna ... to London... and beyond...

Key Issues expressed in the London Communiqué (II)

☞ **Curricular reform** -

- ✓ Degree System (and Teaching / Learning Paradigms)
 - Stabilising the closely related concepts of Learning Outcomes and Credit System
- ✓ Recognition of degrees and study periods
- ✓ Lifelong Learning


☞ **The Substance**

- ✓ Methods - teaching/learning paradigms
- ✓ Contents
- ✓ Mobilizing the Academic Community for changing the Substance


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Qualifications Frameworks

The different layers - from general to specific...

- ☞ High Level Descriptors
 - ✓ Characterize high level groups of qualifications
- ☞ Sectoral Descriptors
 - ✓ Ideally resulting from wide transnational agreements
 - ✓ The TUNING methodology
 - ✓ In Engineering - TU-3 descriptors, CDIO, EUR-ACE, ABET...
- ☞ Specific Descriptors for sub-sectors (see the case of engineering)
 - ✓ For each discipline, thus depending on the sector
 - ✓ Including, if applicable, the identification of professional activities for which the candidates are to be prepared
- ☞ Contents - core curricula - Working Parties on Education...
 - ✓ Learning Outcomes have to earn the trust of society through the specialists opinion, link to Contents and Workload
 - ✓ Significant work of European Working Parties...

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Qualifications Frameworks and the Directive for Recognition of Professional Qualifications


☞ **Three major documents**

- ✓ The EQF-EHEA - European 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 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**
 - National laws should have been passed in all EC Countries till the end of **2007**

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Three major documents The Directive for Recognition of Professional Qualifications (I)


☞ **Article 11 - Five levels of qualification particularly relevant for professions that are out of the Annex**

- ✓ **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


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Three major documents


III - The Directive for Recognition of Professional Qualifications (II)

- ☞ Art. 11, e)
...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)
...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)
...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...

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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
Short Cycles Linked to or Within First Cycles	Level 5	Art 11° c)
First Cycles	Level 6	Art. 11° d)
Second Cycles	Level 7	Art. 11° e)
Third Cycles	Level 8	



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Qualifications Frameworks and the Directive


A striking coincidence or concerted action?

- ☞ The EQF-EHEA, the EQF-LLL and the Directive point out in the same direction
 - ✓ Recognition of different qualification levels linked to formal education
- ☞ They fit remarkably well in the world of engineering and the offer of engineering education in Europe
- ☞ They should obviously be translated into our Quality Assurance Systems


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Quality Assurance in Engineering Education


Programme Outcomes for Accreditation

- ☞ Quality assurance procedures rely on accepted qualifications frameworks
- ☞ Programme outcomes for accreditation should 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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The EUR-ACE System for Quality Assurance Project Aims

- ☞ **European Project that aimed at establishing an European System for Qualification of Engineering Education programmes**
- ✓ **to ensure suitability of programme as entry route to the [engineering] profession**
- ☞ **14 European Institutions, among them the Portuguese Institution of Engineers**
- ✓ **FEANI, SEFI, CESAER, EUROCADRES, ENQHEEI, ASIIN, CTI, IEI, CoPI, UNIFI, OE, UAICR, RAEE, EC-UK**
- ☞ **Supported by the European Commission (DG EaC) within SOCRATES and TEMPUS programmes; Concluded in 2005**

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The EUR-ACE System for Quality Assurance 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**


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EUR-ACE Implementation

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

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

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

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To say what I am going to say...

- ① Mission of Ordem dos Engenheiros - Engineers Portugal
- ② Why all this effort of Quality Assurance?
 - ② The European Model for Development and the Bologna Process
- ③ Some Key Issues of the Bologna Process
 - ③ European Qualifications Frameworks and the Directive for Professional Recognition; Academic Degrees; Quality Assurance
- ④ **A Note about the Degree System and offer of Education in Portugal**
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Academic Degree Structures


I - Concerning levels of qualification - (II) - Art. 11, d) and e)

- ☞ **Two levels of qualifications** associated to those levels approved in the Directive
- ☞ **LEVEL 1** - Art. 11, d): (3-4)U + Professional Training $\geq Y$, with $Y=?$
 - **First Cycle Degrees** are the basis for achieving the qualification of **Technical (or Associate) Engineers**, whatever the European designation
- ☞ **LEVEL 2** - Art. 11, e): $\geq 4U$ + Professional Training $\geq X$, with $X=?$
 - **Second Cycle Degrees** are the basis for achieving the qualification of **Engineers, or equivalent European designation**

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Academic Degree Structures

II - 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

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Academic Degree Structures

III - Offer of Programmes


☛ **Three main offers of Programmes in Engineering Education**

- The offer of **First-cycle programmes**, aiming at fulfilling the level of requirements for accreditation and professional recognition of **LEVEL 1**
- The offer of **Second-cycle programmes**, aiming at fulfilling the level of requirements for accreditation and professional recognition of **LEVEL 2**
- The offer of **two-cycle programmes**, within a philosophy of integrated studies, aiming mainly at fulfilling the requirements of accreditation and professional recognition at **LEVEL 2**

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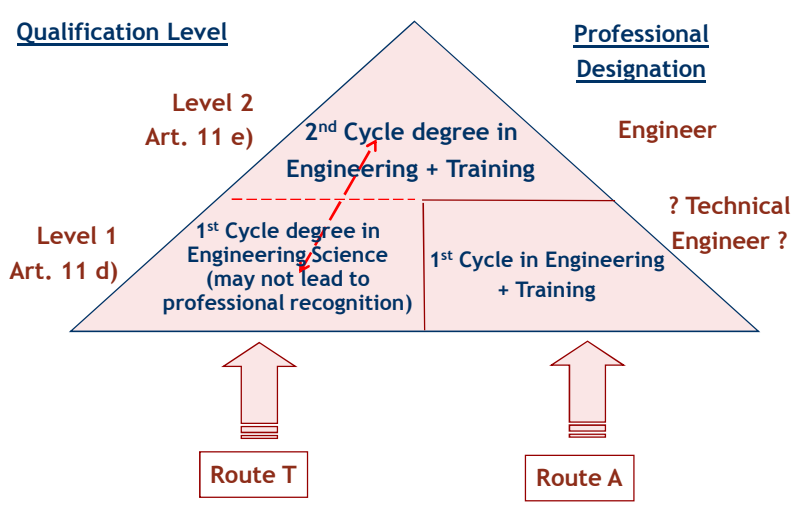


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Academic Degree Structures

IV - Routes for the different qualification levels




The diagram illustrates the academic degree structures for engineering education, organized into a triangular shape representing qualification levels and professional designations.

- Qualification Level** (Left side):
 - Level 2** (Art. 11 e): 2nd Cycle degree in Engineering + Training
 - Level 1** (Art. 11 d): 1st Cycle degree in Engineering Science (may not lead to professional recognition) and 1st Cycle in Engineering + Training
- Professional Designation** (Right side):
 - Engineer** (Level 2)
 - ? Technical Engineer ?** (Level 1)
- Routes** (Bottom):
 - Route T**: Leads to Level 1 (Art. 11 d).
 - Route A**: Leads to Level 1 (Art. 11 d).


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Academic Degrees in Engineering


Understanding fundamental differences between levels of qualifications

- ☞ 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 requirements are mostly related with
 - scope, depth and breath
- ☞ For the Master degree, developing the right **ATTITUDE** to use knowledge or skills in a given situation is a major outcome


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Portugal - Higher Education in Engineering



I - General Information on Degrees and Institutional Network



- ☞ 47 First Cycle Degrees in Engineering Sciences
- ☞ 253 First Cycle Degrees in Engineering
- ☞ 47 Integrated Master Degrees
- ☞ 135 Second Cycle Masters
- ☞ 64 Schools of Engineering in 45 Institutions of Higher Education
 - ✓ 31 institutions of the public subsystem
 - 14 Universities with their 18 University Schools
 - 17 Polytechnic Institutes with their 29 Polytechnic Schools
 - ✓ 14 Institutions of the Private and Concordatary subsystem
 - 7 Universities with their 7 University Schools
 - 7 Higher Education Institutions with 10 Polytechnic Schools


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	Portugal, 2008-2009 - Higher Education Degrees in Engineering Number of Degrees Offered - IM, M2, L5 e L3			
	Totais		Total of IM + L5 + L3 - 315	
			Total of IM + M2 - 182	
		47	135	15
				253
		IM - Integrated	M2 - Masters	L5 - Licenciaturas
		Masters	Second Cycles	Pre-Bologna
				L3 - Licenciaturas
				First Cycles
U-Pub	47	100	5	64
Pol-Pub	0	20	0	144
ESPMP	0	0	5	0
U-Priv	0	6	5	25
Pol-Priv	0	0	0	15
UCP	0	9	0	5
Source - DGES, in www.dges.mctes.pt/DGES/pt , active on 2008.08.14; Data from Public Sector for 2008-2009; Data from Private Sector referred to 2007/08				
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The Qualification System of *Ordem dos Engenheiros* II - New Approach - Methodological Guidelines (I)


☞ **New fresh approach based on EUR-ACE Framework Standards**

- ✓ **By requisites**
 - 3 Pre-requisites
 - 16 Requisites
- ✓ **Focused to the professional practice**
- ✓ **Evaluation on the basis of evidence**
- ✓ **Emphasis on quality improvement**
- ✓ **Follow-up of the quality plan of programmes**
- ✓ **Obeying EUR-ACE standards and procedures**
- ✓ **Seeking accreditation of OE by ENAEE**


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The Qualification System of *Ordem dos Engenheiros* II - New Approach and Methodological Guidelines (II)


☞ **The 3 Pre-Requisites**

- ✓ **LEGITIMACY OF THE FUNCTIONING OF THE COURSE**
- ✓ **ORGANIZATION OF THE PROCESS**
- ✓ **QUALIFICATION AWARDED**


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🔑 The 15 Requisites

REQUISITE 1 -	STRATEGY OF THE HIGHER EDUCATIONAL INSTITUTION WITH REGARD TO THE COURSE UNDER CONSIDERATION
REQUISITE 2 -	COURSE DEVELOPMENT
REQUISITE 3 -	COOPERATION WITH OTHER INSTITUTIONS
REQUISITE 4 -	SPECIFIC COMPETENCES AND MINIMUM REQUIREMENTS
REQUISITE 5 -	CURRICULUM STRUCTURE AND PEDAGOGIC PROGRAMME
REQUISITE 6 -	CHARACTERIZATION OF THE CONTENTS OF ACADEMIC ACTIVITIES
REQUISITE 7 -	OUTCOMES
REQUISITE 8 -	TEACHING STAFF ADEQUACY

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🔑 The 15 Requisites (Cont.)

REQUISITE 9 -	INVOLVEMENT OF THE TEACHERS IN THE RUNNING OF THE COURSE
REQUISITE 10 -	ADMISSION, MONITORING AND EVALUATION OF THE STUDENTS
REQUISITE 11 -	EVALUATION OF THE COURSE BY STUDENTS, RECENT GRADUATES AND EMPLOYERS
REQUISITE 12 -	SUITABILITY OF PREMISES
REQUISITE 13 -	PEDAGOGIC RESOURCES
REQUISITE 14 -	COURSE MONITORING
REQUISITE 15 -	CORRECTIVE ACTIONS AND QUALITY ASSURANCE PLAN

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III - OE vision regarding the Assessment of Outcomes

- ☞ **Knowledge and understanding outcomes** are supported by the modules dossiers, including problem solving and exam papers
- ☞ **Engineering analysis** is supported by practical work based in real or virtual engineering problems presented to the students.
- ☞ **Engineering design** is mandatory and its importance is crucial for an adequate Engineering formation.
- ☞ **Engineering practice** is evaluated with the training period in industries and investigation and development institutions.
- ☞ **Transferable skills** can be assessed with the human environment of the school and the students sensibility to professional context. The use of foreign languages are stimulated with the appointment of foreign handbooks.

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IV - Conformity with EUR-ACE


☞ For the 6 areas of competence of EUR-ACE - A MAPPING of map EUR-ACE requirements with OE requirements, Documental Evidence and personal evidence. Eg. For **ENGINEERING PRACTICE**

Second Cycle graduates should have:			
EUR-ACE	OE	Documental Evidence	Personal Interview Evidence
The ability to integrate knowledge from different branches, and handle complexity;	The graduate must be able to apply different tools, having a realistic and integrated overview of Engineering activities and the way they must work together within the same objective.	Course content; Case studies; Stimulated discussions; Documentation access tools.	Applications experience; A broad knowledge of Engineering; ability to synthesize; Objectiveness.

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V - General Aspects of the Procedure


☞ **National Admission and Qualification Council runs the Qualification process**

- ✓ School Application, following the procedures approved by OE's National Board
- ✓ Appointment of Evaluation Panel, with 3-4 members
- ✓ Analysis of dossier submitted
- ✓ 1 ½ Day Visit - See programme structure
- ✓ Report and Decision

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VI - Programme Structure for the Visit


1st day

15:00- 16:30	Discussion concerning the strengths/weaknesses of the programme
17:00-19:30	List by each member of the main question to be put
20:00-22:00	Dinner with the Dean and assessors

2nd day

9:30-10:00	Welcome Reception;
10:00-11:30	Presentation of the School; Discussion on scientific and educational issues;
11:30-12.30	Visit to communal facilities: School Library; Study Rooms, Amphitheatre, Computer Room, etc.;
12:30-14:00	Business Lunch;
14:00-15:30	Specialised Facilities: Laboratories for Basic Sciences, Engineering Sciences and Specialised Subjects, Workshops, Sites and Experimental Facilities;
15:30-16:30	Interviewing Teaching Staff;
16:30-17:30	Interviewing of Students;
17:30-18:00	Meeting of the Assessment Commission;
18:00	Formal Farewell.

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VII - Report and Decision

- ☞ After the visit the Commission must prepare a compliance analysis report
- ☞ Proposal of decision on the form:
 - ✓ **NOT ACCEPTABLE** to grant the EUR-ACE Label, or
 - ✓ **ACCEPTABLE** to grant the EUR-ACE Label (valid for six years), which may be given with recommendations (the general case) or restrictions
- ☞ National Board decides

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VIII - Dissemination - opening to all engineering degrees

- ☞ First phase - three courses are currently under review:
 - ✓ Biological Engineering, IST-UTL
 - ✓ Mechanical Engineering, FEUP
 - ✓ Electronics and Telecommunications, U.Aveiro
- ☞ Process will be carried out during October-November 2008
- ☞ The implementation will be expanded:
 - ✓ Invitation to submission to all institutions/courses, immediatly after closing the first phase

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To say what I am going to say...

- ① Mission of Ordem dos Engenheiros - Engineers Portugal
- ② Life Today - The European Model for Development and the Bologna Process
- ③ Some Key Issues of the Bologna Process
 - ③ European Qualifications Frameworks and the Directive for Professional Recognition; Quality Assurance
- ④ A Note about the Degree System and offer of Education in Portugal
- ⑤ EUR-ACE and the Qualification System of Engineers Portugal
 - ⑤ Framework; OE's procedure and its conformity with EUR-ACE
- ⑥ Concluding Notes

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Bologna and Routes for Professional Qualification and Transnational Cooperation

- ☞ 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

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From Bologna ... to London... and beyond...


The 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**
- ✓ **ACCEPTED QUALITY ASSURANCE PROCEDURES**


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Quality Assurance - EUR-ACE - Engineers Portugal

- ☞ Engineers Portugal understands Quality Assurance based in international (European) standards as a major tool for National and European development
- ☞ The migration of our standards for quality assurance, from the original standards of 1994 to today's standards based on and in conformity with EUR-ACE are just a demonstration of such understanding
- ☞ Quality Assurance aiming at awarding EUR-ACE labels has just started and for sure will have still more impact in the quality of higher education in the engineering area than that of the previous qualification system

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