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

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1st International ISEKI_Food Conference,
10 September 2008, ESB-UCP, Porto, Portugal

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
   1 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
   1 Framework; OE’s procedure and its conformity with EUR-ACE
6 Concluding Notes
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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.
Ordem dos Engenheiros - Engineers Portugal
I - Legal Framework and Mission Statement (II)

- 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

Ordem dos Engenheiros - Engineers Portugal
I - Legal Framework and Mission Statement (III)

- 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
Ordem dos Engenheiros - Engineers Portugal
Membership - Numbers

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

Professional Titles and Professional Regulation 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.
Ordem dos Engenheiros - Engineers Portugal
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, ASIN, 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

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

SFA, IGESI 2008, 10 September, 2008 www.fe.up.pt/~sfeya sfeya@fe.up.pt
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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......
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

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

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
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...

Qualifications Frameworks and the Directive
A striking coincidence or concerted action?

<table>
<thead>
<tr>
<th>Bologna EQF-EHEA CYCLES</th>
<th>European Union EQF-LLL LEVELS</th>
<th>EU-Directive of Professional Recognition Art. 11 - LEVELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Cycles Linked to or Within First Cycles</td>
<td>Level 5</td>
<td>Art 11° c)</td>
</tr>
<tr>
<td>First Cycles</td>
<td>Level 6</td>
<td>Art. 11° d)</td>
</tr>
<tr>
<td>Second Cycles</td>
<td>Level 7</td>
<td>Art. 11° e)</td>
</tr>
<tr>
<td>Third Cycles</td>
<td>Level 8</td>
<td></td>
</tr>
</tbody>
</table>
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

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
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
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

To say what I am going to say...

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2. Why all this effort of Quality Assurance?
   - The European Model for Development and the Bologna Process
3. Some Key Issues of the Bologna Process
   - European Qualifications Frameworks and the Directive for Professional Recognition; Academic Degrees; Quality Assurance
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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 >= 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): >= 4U + Professional Training >= X, with X=?
  - Second Cycle Degrees are the basis for achieving the qualification of Engineers, or equivalent European designation

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
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

Academic Degree Structures
IV - Routes for the different qualification levels
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
### Portugal - Higher Education in Engineering
#### II - The offer of Academic Degrees

**Portugal, 2008-2009 - Higher Education Degrees in Engineering**

**Number of Degrees Offered - IM, M2, L5 e L3**

<table>
<thead>
<tr>
<th>Totals</th>
<th>Total of IM + L5 + L3 - 315</th>
<th>Total of IM + M2 - 182</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>47</td>
<td>135</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>U-Pub</th>
<th>M2 - Masters</th>
<th>L5 - Licenciaturas</th>
<th>L3 - Licenciaturas</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM - Integrated Masters</td>
<td></td>
<td>Second Cycles</td>
<td>Pre-Bologna</td>
<td>First Cycles</td>
</tr>
<tr>
<td>U-Pub</td>
<td>47</td>
<td>100</td>
<td>5</td>
<td>64</td>
</tr>
<tr>
<td>Pol-Pub</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>144</td>
</tr>
<tr>
<td>ESPMP</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>U-Priv</td>
<td>0</td>
<td>6</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Pol-Priv</td>
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<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>UCP</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

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

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

**The 15 Requisites**

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

**The 15 Requisites (Cont.)**

9. INVOLVEMENT OF THE TEACHERS IN THE RUNNING OF THE COURSE
10. ADMISSION, MONITORING AND EVALUATION OF THE STUDENTS
11. EVALUATION OF THE COURSE BY STUDENTS, RECENT GRADUATES AND EMPLOYERS
12. SUITABILITY OF PREMISES
13. PEDAGOGIC RESOURCES
14. COURSE MONITORING
15. CORRECTIVE ACTIONS AND QUALITY ASSURANCE PLAN
The Qualification System of Ordem dos Engenheiros
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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The Qualification System of Ordem dos Engenheiros
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

<table>
<thead>
<tr>
<th>Second Cycle graduates should have:</th>
<th>EUR-ACE</th>
<th>OE</th>
<th>Documental Evidence</th>
<th>Personal Interview Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ability to integrate knowledge from different branches, and handle complexity;</td>
<td>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.</td>
<td>Course content; Case studies; Stimulated discussions; Documentation access tools.</td>
<td>Applications experience; A broad knowledge of Engineering; ability to synthesize; Objectiveness.</td>
<td></td>
</tr>
</tbody>
</table>

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SFA, ISPEI 2008, 10 September, 2008  www.fe.up.pt/~sfeva  sfey@fe.up.pt
The Qualification System of *Ordem dos Engenheiros*

**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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The Qualification System of *Ordem dos Engenheiros*

**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.
The Qualification System of *Ordem dos Engenheiros*
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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The Qualification System of *Ordem dos Engenheiros*
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, immediately after closing the first phase
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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
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

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