

## **EUR-ACE®:**

### **A common European quality label for accredited Engineering Programmes**

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***Abstract** – EUR-ACE is a decentralized Europe-based accreditation system of educational programmes as entry route to the engineering profession (“pre-professional accreditation”): a common quality label (EUR-ACE® label) is awarded to programmes that satisfy a common basic set of standards (“EUR-ACE Framework Standards for the Accreditation of Engineering Programmes”) and are accredited by an Agency fulfilling appropriate Quality Assurance prescriptions, including in particular the European Standards and Guidelines for Quality Assurance in Higher Education (ESG) adopted in 2005 by the Bergen Ministerial Conference. EUR-ACE is currently (May 2010) implemented by seven Agencies throughout the European Higher Education Area (CTI, France; EngC, UK; Engineers Ireland; OE, Portugal; ASIIN, Germany; MÜDEK, Turkey; RAEE, Russia): a total of approximately 480 labels have been awarded. EUR-ACE has been quoted by the European Commission as an example of good practice in their “Report on progress in quality assurance in higher education” (September 2009) and mentioned also in the publication “The EU contribution to the European Higher Education Area”, issued in March 2010 in occasion of the “Bologna Anniversary Conference”. In this paper, the EUR-ACE Framework Standards are summarized and the EUR-ACE system described. Current contacts and initiatives aimed at spreading EUR-ACE in other countries (Belgium, Denmark, Italy, Lithuania, the Netherlands, Poland, Romania, Switzerland, ...) are also illustrated. The significance of the EUR-ACE label for improving quality and transparency of engineering education is discussed.*

***Index Terms** - Accreditation, Bologna process, Engineering Education, European Union, European Higher Education Area (EHEA).*

## **INTRODUCTION**

EUR-ACE<sup>1</sup> is a Europe-based system in which a common quality label (EUR-ACE® label) is awarded to engineering educational programmes that satisfy a common basic set of standards (EUR-ACE Framework Standards for the Accreditation of Engineering Programmes [1]) and are accredited by an Agency fulfilling appropriate Quality Assurance (QA) prescriptions, in particular the “European Standards and Guidelines for Quality Assurance in Higher Education” (ESG) adopted in 2005 within the “Bologna Process” by the Bergen Ministerial Conference [2]. The EUR-ACE label ensures the suitability of the accredited programme as entry route to the engineering profession (“pre-professional accreditation”).

At the ICEE 2007 held in Coimbra, EUR-ACE and ENAEE (the European Network for Accreditation of Engineering Education, established in February 2006 to run the EUR-ACE system) were presented in a panel discussion at a Plenary Session [3] and in a contributed paper [4]. Since that time, EUR-ACE started its implementation throughout the European Higher Education Area (EHEA). Six Agencies (‘Commission des Titres d’ Ingénieur’ [CTI], France; Engineering Council [EngC], UK; Engineers Ireland; Ordem dos Engenheiros [OE], Portugal; ‘Accreditation Agency for Study Programs in Engineering, Informatics, Natural Sciences and Mathematics’ [ASIIN], Germany; Russian Association for Engineering Education [RAEE], Russia) are authorized since November 2006 to award the EUR-ACE label; a seventh Agency (‘Association for Evaluation and Accreditation of Engineering Programs’ [MÜDEK], Turkey) was added in January 2009. At the time of writing (May 2010) a total of approximately 480 labels have been awarded, while several contacts and initiatives – illustrated in a later Section - are open to spread EUR-ACE in other countries (Belgium, Denmark, Italy, Lithuania, the Netherlands, Poland, Romania, Switzerland, ...) either by authorizing other (possibly newly created) Agencies to award the EUR-ACE label, or thanks to the activity of already authorized Agencies (CTI, ASIIN, EngC, RAEE) out of their own country.

EUR-ACE has been quoted as an example of good practice of QA in Higher Education in an official report by the European Commission [5] and in an EU publication issued on the occasion of the March 2010 “Bologna Anniversary Conference”[6].

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<sup>1</sup> Acronyms are defined when they first appear but, to facilitate reading, are also collected in an ad-hoc Appendix at the end of the paper.

Both the EUR-ACE Framework Standards and the EUR-ACE system will be described in this paper. However, since the initial stages of EUR-ACE and ENAEE have been already illustrated in Journals, books and Conferences [7]-[14], this paper, albeit being self-contained, focuses on the latest developments.

## THE EUR-ACE FRAMEWORK STANDARDS

At the very beginning of the EUR-ACE exercise, a preliminary detailed survey of the standards used by the specialized engineering accreditation agencies throughout Europe revealed striking similarities behind different façades. This made the compilation of a set of shared accreditation standards and procedures comparatively easy: the result was the first draft of the “EUR-ACE Framework Standards”.

Unlike the old national rules that prescribed inputs in term of subject areas and teaching loads, the EUR-ACE Framework follows the trend of the most recent Standards, and define and require “learning outcomes”, that is, what must be learned rather than how it is taught. This approach that has several direct advantages, like:

1. it respects the many existing traditions and methods of engineering education in Europe;
2. it can accommodate developments and innovation in teaching methods and practices;
3. It encourages the sharing of good practice among the different traditions and methods;
4. it can accommodate the development of new branches of engineering.

The EUR-ACE Framework Standards were finalized in 2006 together with an explanatory “Commentary”, after successive versions had been commented on by the project partners and other stakeholders, both academic and non-academic, and trial accreditations were run in a number of EHEA countries to test their efficacy. Minor modifications have been made in 2008 [1][15]. A thorough revision is currently (2010) under way, together with a check of their consistency with other significant Standards and prescriptions (in particular the ESG), but not many significant changes are expected.

In accord with the European Qualification Frameworks QF-EHEA [16] and EQF-LLL [17] the EUR-ACE Standards distinguish between First and Second Cycle degrees: indeed, they address the five generic qualification dimensions defined at each level in [16][17] by specifying and expanding them with regard to engineering (for a detailed critical comparison, see [18]), taking also into account the EU Directive on the Recognition of Professional Qualifications [19]. In particular, the EUR-ACE Standards identify 21 programme outcomes for First Cycle degrees (FCD) and 23 for Second Cycle Degrees (SCD), grouped under six headings:

- Knowledge and understanding
- Engineering analysis
- Engineering design
- Investigations
- Engineering practice
- Transferable skills

The EUR-ACE Standards also contain guidelines and procedures that include the assessment, among other requirements, of the human resources and facilities available for the programme.

In order to be as flexible and comprehensive as possible, and not to exclude any European-compatible accreditation system, the EUR-ACE Standards encompass all engineering disciplines and profiles, and distinguish only between First and Second Cycle degrees (FCD, SCD). However, the Standards are also applicable to the accreditation of programmes leading directly to a degree equivalent to a Second Cycle Degree (conventionally termed ‘Integrated Programmes’), which constitute an important part of European engineering education, especially but not only in the oldest continental Technical Universities and Schools.

In some European countries, in addition to the distinction between FC and SC degrees, engineering degrees are characterised by profiles; moreover, accreditation distinguishes between engineering branches (disciplines) in some countries, and not in others. The EUR-ACE Framework Standards can accommodate all these differences but they must be interpreted, and, if necessary, integrated to reflect the specific demands of different branches, cycles and profiles. However, they leave to Higher Education Institutes (HEIs) the freedom to formulate programmes with an individual emphasis and character, including new and innovative programmes, and to prescribe conditions for entry into each programme.

A major difficulty in establishing and verifying the actual achievement of learning outcomes, and of differentiating between cycles, is that of specifying an absolute standard. This is true for any outcome-based Standard, but particularly so in engineering because the standard must apply consistently to the many different and overlapping branches, and should also be applicable to new branches that continuously emerge as a result of scientific and technical developments.

The EUR-ACE Framework expresses the learning outcomes to be achieved by FC and SC graduates in the three direct engineering requirements (“Engineering Analysis”, “Engineering Design” and “Investigations”) by the phrase “consistent with their level of knowledge and understanding”, and this level is described using the concept of the forefront of the particular branch of engineering. For instance, in the requirement “Knowledge and Understanding” the

relevant phrase is for First Cycle graduates, “coherent knowledge of their branch of engineering including some at the forefront of the branch” and for Second Cycle graduates “a critical awareness of the forefront of their branch”.

It would be extremely difficult, if not impossible, to obtain an agreed specification of the forefront for all engineering disciplines, and, even if this could be obtained, a fixed specification might inhibit innovation in programme design and teaching methods. Nor would it be relevant or applicable to new and emerging technologies. The identification of the forefront of the branch is the responsibility of the members of the accrediting panel who are experts in that particular branch of engineering, while the body responsible for the final accreditation verdict will review and assess the rationale for their decision.

Note finally that the EUR-ACE Framework has been taken, together with the ABET criteria [20], as the basis of a “Conceptual Framework of expected/desired Learning Outcomes in Engineering” developed by the OECD-sponsored Tuning-AHELO project [21], that in turn should be the starting point for the further developments of the very ambitious OECD-supported AHELO initiative.

## **THE EUR-ACE SYSTEM**

The EUR-ACE Framework does not intend to substitute for national standards, but to provide a common reference framework as the basis for the award of a common European quality label (the EUR-ACE<sup>®</sup> label). Consequently, the EUR-ACE accreditation system was envisaged as based on a bottom-up approach involving the active participation of national accreditation agencies and leading at the end to a multilateral mutual recognition agreement. A supra-national European Engineering Accreditation Board was considered, but soon discarded and never proposed: accreditation is and will remain the task of national (or regional) agencies; the EUR-ACE label will be a complement to the national accreditation, aimed at giving them an international value. This decentralized approach, now being implemented, appears to be rather novel in the world-wide panorama of programme accreditation systems.

Indeed, the variety of educational situations and of degrees awarded in Europe makes trans-national recognition of academic and professional qualifications still rather difficult. The already quoted “Bologna Process” is working towards the creation of a *transparent system* of easily readable and comparable degrees in the European Higher Education Area (EHEA), but as far as professional accreditation and recognition are concerned, no generally accepted system or agreement exists on a continental scale: notwithstanding the prestige of national systems and academic titles, this deficiency weakens the position of the European engineer in the global employment market.

The importance of ‘accreditation’ (or, more precisely, of “pre-professional accreditation”, as defined in the Introduction) has been felt for quite some time, although the term ‘accreditation’ did not appear in European documents. As early as 1994, the European Commission issued a communication on the possible synergies between the recognition of qualifications for academic and professional purposes [22]. In 1998-99 the EC-supported Thematic Network “Higher Engineering Education for Europe (H3E)” organized three ‘European Workshops for Accreditation of Engineering Programmes’, that lead to the establishment in September 2000 of the ‘European Standing Observatory for the Engineering Profession and Education’ (ESOPE). ESOPE promoted the EUR-ACE project, and in order to run the system, was transformed into the international not-for-profit association ‘European Network for Accreditation of Engineering Education’ (ENAE), founded in February 2006 by 13 Associations and Agencies interested in engineering education throughout Europe. ENAE has registered the EUR-ACE<sup>®</sup> trademark and authorizes national Agencies to add the EUR-ACE label to their accreditation (this authorization might be defined “meta-accreditation”). Further up-to-date information is available at [www.enaee.eu](http://www.enaee.eu).

In November 2006, ENAE assessed that six Accreditation Agencies (CTI, ASIIN, Engineers Ireland, Ordem dos Engenheiros, RAEE, EC-UK) from six countries (France, Germany, Ireland, Portugal, Russia, UK), all active partners of the EUR-ACE project, already fulfilled the requirements set by the Framework Standards; hence, they were authorized to award the EUR-ACE label for a period of two years. Their meta-accreditation has been renewed in December 2008 after a rigorous re-assessment process including site visits by multi-agency teams.

Two other EC-supported projects (EUR-ACE IMPLEMENTATION and PRO-EAST) have been active between 2006 and 2008, and greatly helped to start up the EUR-ACE system, respectively in the EU and in Russia. Seventy-three (73) programmes obtained the EUR-ACE label in the first year (2007), although only three agencies (ASIIN, Engineers Ireland, RAEE) contributed; at the time of writing (May 2010) the number of awarded labels has raised to about 500.

## **SPREADING THE EUR-ACE SYSTEM: CURRENT INITIATIVES**

Although the six countries constituting the initial core of the EUR-ACE system were a significant sample of the European Higher Education Area (EHEA), their number was only about one-seventh (1/7) of the total number of the EHEA countries (grown to 47 with the addition of Kazakhstan in 2010). Therefore, ENAE is committed not only to strengthen the EUR-ACE system in these six countries, but also to spread it into other EHEA countries.

A document indicating the conditions to be fulfilled and the procedure to be followed by an Agency in order to join

the EUR-ACE system and the relevant application form have been elaborated [23], and another two-year EU-supported project with the self-explanatory name of EUR-ACE SPREAD has started on 1<sup>st</sup> November 2008. This project is targeted mainly to Turkey, Lithuania, Romania, Italy and Switzerland: a “national” partner in each of these countries participates in the project, while ENAEE is the coordinating partner.

The first concrete achievement of EUR-ACE SPREAD has been the addition of the Turkish “Association for Evaluation and Accreditation of Engineering Programs” (MÜDEK) to the initial six EUR-ACE Agencies. MÜDEK had begun accrediting programmes on behalf of the Turkish Engineering Deans Council in 2003, joined ENAEE in 2006, became an independent Association in 2007, and in 2008 applied to be EUR-ACE-accredited. After a careful evaluation of the application and site visits by an ENAEE-appointed panel, on 21 January 2009 MÜDEK became the seventh Agency authorized to award the EUR-ACE label and within that year awarded 29 FCD labels.

It is expected that Agencies from the other four concerned countries will also apply before the end of the project (31 October 2010).

The formal conditions of Romania and Lithuania with regard to quality assurance in higher education are rather similar to each other. A national Agency for the whole higher education has been recently established (respectively the ‘Romanian Agency for Quality Assurance in Higher Education’ (ARACIS) and the Lithuanian ‘Center for Quality Assessment in Higher Education’ (SKVC). ARACIS and SKVC have joined the EUR-ACE SPREAD project with the ultimate aim of being admitted into the EUR-ACE system for what pertains to accreditation of engineering programmes. Two teams of three foreign experts (defined ‘mentors’) have been entrusted by EUR-ACE SPREAD to follow and advise respectively ARACIS and SKVC in order to bring them to satisfy the ENAEE Standards.

A first two-day meeting of the mentors with ARACIS took place in Bucharest in February 2009. As of May 2010, ARACIS is finalizing the revision that should make its standards and procedures for engineering wholly compatible with the EUR-ACE Framework Standards. A second (and probably final) visit of the mentors is scheduled for mid-July.

SKVC had submitted a pro-forma application to join the EUR-ACE system already in December 2008. Comments on this application have been exchanged between the mentors and SKVC officials; a three-day visit of the mentors to Vilnius took place in December 2009; final adjustments of the SKVC provisions are presently in progress

For both ARACIS and SKVC, it is hoped to conclude the process and include the Agencies into the EUR-ACE system within the two-year lifespan of the project.

In Italy, the “Agenzia Nazionale per la Valutazione dell’ Università e della Ricerca” (ANVUR) was the object of a 2007 decree, that however has not been implemented yet; thus, no quality assurance system or accreditation body for Italian Higher Education exists yet. However, the ‘Conference of the Deans of the Italian Engineering Faculties’ (CoPI) has been concerned with accreditation for a long time: indeed, in the late ’90s CoPI elaborated a “National System for Accreditation of Engineering Study Programmes” (SINAI), that unfortunately remained at the stage of proposal. CoPI was one of the founders of ESOEPE in 2000, and one of the most active partners of the EUR-ACE and EUR-ACE IMPLEMENTATION projects: as a matter of fact, the general model behind the EUR-ACE Standards coincides with the model behind the pilot projects of HE evaluation ‘Campus’ and ‘CampusOne’, run between 1995 and 2004 by the ‘Conference of the Italian University Rectors’ (CRUI) with CoPI’s collaboration. The EUR-ACE proposals have been summarized in a Volume published by CoPI [24] and illustrated in a two-day Workshop held in May 2008 [25]. Now, CRUI and CoPI, together with the Italian Engineers’ Association ‘Consiglio Nazionale degli Ingegneri’ (CNI), the Industrialists’ Association (Confindustria) and the Association of Commerce & Industry Chambers (Unioncamere), are working to set up an Agency dedicated to the EUR-ACE accreditation of engineering degree programmes. EUR-ACE SPREAD is following closely and supporting this initiative.

Several among the EUR-ACE-accredited Agencies accredit engineering programmes also outside their own country: they have been authorized to award the EUR-ACE label to these programmes as well.

This has allowed to award the EUR-ACE label, thanks to an accreditation by ASIIN, to a few FC programmes in the German-speaking Switzerland, while some programmes in the French-speaking Switzerland are already accredited by CTI and can now obtain the EUR-ACE label too. However, EUR-ACE SPREAD is trying to set up and implement a more systematic way to spread the EUR-ACE system into Switzerland: a grant with this specific objective has been received from the Swiss Government, and concrete proposals – that should involve the Swiss National Quality Assurance Agency (OAQ) - are being elaborated.

In March 2010 the Dutch-Flemish official Accreditation Organization NVAO (the only body legally authorized to accredit HE programmes in the Netherlands and in Flanders, i.e. the Dutch-speaking part of Belgium) has formally applied to join the EUR-ACE system. The application is now under scrutiny: it is to be noted that NVAO accredits the programmes on the basis of an assessment by independent Agencies, therefore, ENAEE should be satisfied that in this assessment the EUR-ACE Standards are taken into due account. Anyway, it is expected to conclude positively this procedure within a few months.

As for the French-speaking part of Belgium, CTI has been contacted both by some Faculty Deans and by AEQES (the agency in charge of quality assurance in that region), and will run accreditation visits from 2012, including the award of EUR-ACE labels. Indeed, CTI has already awarded the EUR-ACE label to a programme of the Belgian Royal Military

Academy in Brussels.

Also KAUST, the Polish Committee for Accreditation of Technical Universities, has decided to apply for joining EUR-ACE: their application form is expected in the Summer 2010.

Finally, several programmes have been accredited in Kazakhstan (the 47<sup>th</sup> and latest country to join the “Bologna process”) by RAEE. They will get the EUR-ACE label, while efforts to set-up National Engineering Accreditation Agencies in Central Asia countries have started.

Anyway, single HEIs from any EHEA country can apply, either to a specific Agency or through the ENAEE Secretariat, to have their programmes awarded the EUR-ACE label. This may be another way to start spreading the system into some countries. The EUR-ACE label may also be awarded outside the EHEA. Indeed, signals of interest for this possibility have already reached the ENAEE Headquarters and may be followed in the near future by concrete initiatives.

Another EU-supported 3-year project, called EUGENE (EUropean and Global ENgineering Education), started in November 2009 and is expected to contribute to further strengthening and spreading of EUR-ACE. In fact, within the general objectives of “improving the impact of European Engineering Education on competitiveness, innovation and socio-economic growth in a global context”, the EUGENE workplan devotes the whole “Activity Line C”, lead by ENAEE, to the aim of “improving trans-national mobility of engineering students, graduates and professionals, also through contacts and synergies with the International Engineering Alliance and the Washington Accord”.

ENAEE is also active, either directly or through “experts”, in the successive stages of the OECD global initiative for “Assessment of Higher Education Learning Outcomes (AHELO)” aimed at “assessing Learning Outcomes on an international scale by creating measures that would be valid for all cultures and languages”. In the preliminary stage of the AHELO initiative, the experts indicated by ENAEE have been instrumental in formulating the “Conceptual Framework of Expected/Desired Learning Outcomes in Engineering” [21], that draws heavily from the EUR-ACE Framework Standards.

## CONCLUDING REMARKS

If coupled with rigorous Quality Assurance rules, as it should always be, programme accreditation assures that an educational programme is not only of acceptable academic standard, but also that it prepares graduates who are able to assume relevant roles in the job market. The participation of non-academic stakeholders in the process is a guarantee to this effect. An internationally recognized qualification like the EUR-ACE label, added to the national accreditation, will facilitate job mobility as well. [26]

It is fair to state that the EUR-ACE system, compared with other existing trans-national engineering accreditation systems and in particular with the Washington-Sydney-Dublin accords [27], is at the same time simpler and more flexible. In fact, contrary to the Washington and Sydney accords, EUR-ACE does not create a rigid barrier between ‘engineers’ and ‘technologists’, which would be against the spirit of the Bologna Process and in many languages even not understandable; at the same time, EUR-ACE allows national differences and appropriate distinction between the cycles.

Benchmarking the two systems will indeed be a major challenge for EUR-ACE; another will be testing the consistency and actual applicability in our specific discipline (engineering) and in its different “branches” of Dublin Descriptors, EQF and EU Directive on professional qualifications [18].

But, apart from technical and operational difficulties, creating a pan-European scheme like the new-born EUR-ACE system certainly finds major difficulties in the great differences between educational practices, legal provisions and professional organizations across the different European countries. These are, however, the typical difficulties encountered in building a unified, but not homogenized, Europe. The fact, that common Standards could be written and can be now implemented from Portugal to Russia, in continental and Anglo-Saxon countries, is a matter of great pride for us, the initiators of EUR-ACE.

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## APPENDIX: ACRONYMS USED IN THE PAPER

ABET: Accreditation Board for Engineering and Technology (USA)  
AHELO: Assessment of Higher Education Learning Outcomes  
ASIIN: Accreditation Agency for Study Programs in Engineering, Informatics, Natural Sciences and Mathematics  
(Fachakkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik)  
CTI: Commission des Titres d' Ingénieur  
EC: European Commission (*formerly* Commission of the European Communities)  
EHEA: European Higher Education Area (the countries, now 47, participating in the “Bologna Process”)  
ENAE: European Network for Accreditation of Engineering Education  
EngC: Engineering Council, United Kingdom  
Engineers Ireland (*formerly* IEI: Institution of Engineers, Ireland)  
EQF-LLL: European Qualifications Framework for Lifelong Learning (2008)  
ESG: European Standards and Guidelines for Quality Assurance in Higher Education  
ESOEPE: European Standing Observatory for the Engineering Profession and Education (2000-2006)  
EU: European Union  
EUGENE: European and Global ENgineering Education (an EC-supported “Academic Network”)  
EUR-ACE: European Accredited Engineer (acronym of a series of EC-supported projects, now an accreditation system)  
FC: First cycle; FCD: First cycle degree (as defined in QF-EHEA and EQF-LLL)  
HE: Higher (post-secondary) education  
HEI: Higher Education Institution (any provider of HE: University, Fachhochschule, etc.)  
ICEE: International Conference on Engineering Education  
MÚDEK: Association for Evaluation and Accreditation of Engineering Programs  
OE: Ordem dos Engenheiros (Engineers’ Guild)  
OECD: Organisation for Economic Co-operation and Development (OCSE in Latin languages)  
QA: Quality Assurance  
QF-EHEA: Qualifications Framework for the European Higher Education Area (2005)  
RAEE: Russian Association for Engineering Education  
SC: Second cycle; SCD: Second cycle degree (as defined in QF-EHEA and EQF-LLL)