Spreading the EUR-ACE® Accreditation System of Engineering Education: Current Status and Perspectives

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Abstract

The EUR-ACE system is a decentralized accreditation system of engineering education programmes, in which a common European quality label (the EUR-ACE® label) is added to the accreditation awarded by a national Agency, under the condition that the EUR-ACE Framework Standards are satisfied. This system is run by the European Network for Accreditation of Engineering Education (ENAEE), proprietor of the EUR-ACE® trademark. Seven Agencies (CTI, ASIIN, Engineers Ireland, Ordem dos Engenheiros, RAEE, MÜDEK, EC-UK) in seven EHEA countries (France, Germany, Ireland, Portugal, Russia, Turkey, UK) are at present authorized to award the EUR-ACE label: approximately 300 programmes are EUR-ACE-accredited at the time of writing (August 2009).
The seven countries of the present EUR-ACE system are already a significant and varied sample of the European Higher Education Area (EHEA) but their number is still a fraction of the 46 EHEA countries: therefore, ENAEE is now committed to spread the EUR-ACE system into other countries and coordinates the EC-supported project EUR-ACE SPREAD that aims at bringing Italy, Lithuania, Romania and Switzerland into the system.

Keywords: Accreditation, Engineering Programmes, Quality Assurance, Qualification.

1. Introduction

In this paper, like in all EUR-ACE and ENAEE documents, "accreditation" of an engineering educational programme is defined as the primary result of a process used to ensure the suitability of that programme as the entry route to the engineering profession (ENAEE, 2008b). Accreditation is referred to a specific engineering programme and not to Departments or Higher Education Institutions (HEIs). Accreditation ensures that the relevant programme has attained the standards required for its graduates to acquire the necessary educational qualifications to enter the engineering profession.
"Accreditation" involves a periodic assessment against accepted standards of engineering education. It is essentially based on a peer review process, undertaken by appropriately trained and independent teams comprising peers from both academia and engineering practice. The process normally involves both scrutiny of data and a structured visit to the HEI running the programme. The accreditation process should be carried out by properly constituted national accreditation agencies or institutions or consortia thereof.
Discipline-specific accreditation is usually conferred on individual educational programmes rather than departments or HEIs. However, this does not exclude and, on the contrary, is facilitated by an overall system of QA that authorizes only quality HEIs to deliver academic degrees.
Engineering has always been in the forefront of discipline-specific accreditation, which in many cases has preceded general QA systems. Therefore, several national Engineering Accreditation Agencies throughout Europe have a long tradition: examples are the French 'Commission des Titre d' Ingénieur' established by a 1934 Law, and the Engineering Council-UK, an organisation set up by Royal Charter in the 1980s to regulate the engineering profession through 36 Engineering Institutions, some of which date back to the 19th Century.
Most of these national Engineering Accreditation Agencies, including CTI and EC-UK, were partners of the EUR-ACE (EURopean ACredited Engineer) project (2004/06), that formulated European Standards for the accreditation of engineering programmes and indicated the main lines of a decentralized accreditation system in which a common European quality label (the EUR-ACE label) is added to the accreditation awarded by a national Agency. The European Network for Accreditation of Engineering Education (ENAEE) has been established to run this system.
The successive stages of EUR-ACE and ENAEE have been illustrated in Journals and books, and at several Conferences, including GCEE 2008 (Augusti, 2005-2009; Augusti et al., 2008): therefore this paper, albeit being self-contained, focuses on the latest and current developments.

2. The EUR-ACE Framework Standards

The EUR-ACE project set as its first and foremost task the compilation of a set of shared standards and procedures (EUR-ACE Framework Standards) for the accreditation of engineering programmes. A preliminary detailed survey of the standards used by the partners revealed striking

similarities behind different façades, which made this task comparatively easy.

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

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; and
4. it can accommodate the development of new branches of engineering.

The definitive text of the EUR-ACE Framework Standards was finalized in 2006 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. Very minor modifications have been made in 2008 (ENAEE, 2008a)

In accord with the European Qualification Framework (EQF, 2005), the EUR-ACE Standards distinguish between First and Second Cycle degrees, and identify 21 outputs for accredited First Cycle degrees and 23 for Second Cycle Degrees, 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. The Standards are consistent with the whole "Bologna Process", and in particular with the Dublin Descriptors (JQI, 2004), the Framework for Qualifications of the European Higher Education Area (in short European Qualification Framework) (EQF, 2005) and the Standards and Guidelines for Quality Assurance in the European Higher Education Area (in short European Standards and Guidelines, ESG) (ENQA, 2005), and also take into account the EU Directive on the Recognition of Professional Qualifications (EU, 2005). Indeed, the EUR-ACE Framework Standards address the five generic qualification dimensions of the EQF on each level by specifying and expanding them with regard to engineering. For a detailed critical comparison, see (Feyo, 2009)

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, and not only in the oldest continental Technical Universities 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, modified 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 programme outcomes, and of differentiating between cycles, is that of specifying an absolute standard. This is 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 will emerge as a result of continuing scientific and technical developments.

The EUR-ACE Framework expresses the standard 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 would 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.

3. 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 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. No supra-national Accreditation Board was ever 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. 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 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 significance of 'accreditation' (using the word 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 (EC, 1994). In 1998-99 the 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' (ESOEPE). ESOEPE 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' (ENAEE), founded in February 2006 by 13 Associations and Agencies interested in engineering education throughout Europe. ENAEE has registered the EUR-ACE® trademark and authorizes national Agencies to add the EUR-ACE label to their accreditation (this authorization may be defined "meta-accreditation"). Further information is available at www.enaee.eu.

In November 2006, ENAEE 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 recently renewed 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; approximately 200 labels have been awarded in 2008, with the contribution of two more Agencies (Ordem dos Engenheiros, CTI).

4. Spreading the Eur-Ace System: Current Initiatives

Although the six countries constituting the initial core of the EUR-ACE system are a significant sample of the European Higher Education Area (EHEA), their number is only about one-seventh (1/7) of the total 46 EHEA countries. Therefore, ENAEE is now 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 to join the EUR-ACE system has been elaborated (ENAEE, 2007) and a new two-year EU-supported project with the self-explanatory name of EUR-ACE SPREAD has started on 1st 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. Other partners are the University of Florence (contracting partner), SEFI, FEANI, EUROCADRES and ASIIN.

The University of Florence coordinates also another EU-supported 3-year project, namely EUGENE (EUropean and Global ENgineering Education), scheduled to start in November 2009 and expected to contribute to further strengthening and spreading of EUR-ACE. In fact, within the general EUGENE objectives of "improving the impact of European Engineering Education (EE) on competitiveness, innovation and socio-economic growth in a global context" its workplan includes a whole Activity Line lead by ENAEE and aimed at "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 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" (OECD, 2009), that draws heavily from the EUR-ACE Framework Standards.

5. The EUR-ACE Spread Project

Since the start of EUR-ACE SPREAD, there has been already a new addition to the EUR-ACE system: the Turkish 'Association for Evaluation and Accreditation

of Engineering Programmes (MÜDEK)'. MÜDEK began accrediting programmes on behalf of the Turkish Engineering Deans Council in 2003, joined ENAEE in 2006, became an independent Association in 2007, and applied to be EUR-ACE-accredited sometime in 2008. After a careful evaluation of the application vs. the ENAEE Standards (ENAEE, 2007) and site visits by an ENAEE-appointed panel, on 21 January 2009 MÜDEK has become the seventh Agency authorized to award the EUR-ACE label and is already active in this direction.

The 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 'Center for Quality Assessment in Higher Education' (SKVC) and move their first steps. 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. The EUR-ACE SPREAD project coordinator has nominated two groups of three foreign experts (defined 'mentors') who will 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. At present, ARACIS is working in order to make its standards and procedures for engineering, now under revision, wholly compatible with the EUR-ACE Framework Standards.

SKVC 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 to Vilnius is planned for December 2009.

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 the founders of ESOEPE in 2000, and one of the most active partners of the EUR-ACE project (2004-2006): 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 'Campus*One*', 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 (Augusti & Squarzoni, 2008) and illustrated in a two-day Workshop held in May 2008 (Borri & Tesi, 2009). Now, CRUI and CoPI are trying to involve relevant stakeholders like the Ministry of Education University and Research (MIUR), the 'Consiglio Nazionale degli Ingegneri' (CNI), the Industrialists' Association (Confindustria), and to set up an Agency dedicated to accreditation of engineering degree programmes. EUR-ACE SPREAD will follow closely this initiative.

Three of the EUR-ACE-accredited Agencies (namely ASIIN, CTI, EC-UK) accredit engineering programmes outside their own country: they have been authorized to award the EUR-ACE label also to these programmes. Thus, thanks to an accreditation by ASIIN, a few FC programmes in the German-speaking Switzerland are already EUR-ACE-accredited, while some programmes in the French-speaking Switzerland are already accredited by CTI and can now obtain also the EUR-ACE label.

However, EUR-ACE SPREAD will try 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 a concrete proposal has been made to the 'Center of Accreditation and Quality Assurance of the Swiss Universities' (OAQ).

ENAEE aims also at spreading the EUR-ACE system into other EHEA countries. A concrete possibility is offered by the contacts with the Dutch-Flemish official Accreditation Organization NVAO (the only body legally authorized to accredit HE programmes in the Netherlands and Flanders): some difficulties have arisen (e.g. due to the fact that NVAO does not accredit directly, but through Agencies) but it is hoped that they will be overcome and Dutch and Flemish engineering programmes will be allowed to obtain the EUR-ACE label.

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, but ENAEE hopes that the SEFI Conference can be the occasion to start a more systematic effort, at least in some countries.

In principle, the EUR-ACE label may also be awarded outside the EHEA. Indeed, signals of interest for this possibility have already been sent to the ENAEE Headquarters and will be pursued in the near future.

6. The global context

Besides the European context, EUR-ACE must confront the global scene, primarily in relation to the Washington Accord, an international agreement originally signed in 1989 by national bodies that accredited engineering programmes in countries following a system of the Anglo-American type (a first cycle [Bachelor] degree after three or four years of study and a second cycle [Master] degree after one or two additional years). At present, full members of the Washington Accord are agencies operating in USA (ABET), UK, Ireland, Canada, Australia, New Zealand, South Africa, Japan, Hong Kong China, Chinese Taipei and Korea.

The Washington Accord recognizes the substantial equivalency of programmes accredited by the signatory bodies and recommends that graduates of programmes accredited by any of them be recognized in the other countries. In this regard, the Washington Accord is analogous to the EUR-ACE system. However, the EUR-ACE system mutual recognition stems from a common quality label awarded by the participating agencies on the basis of shared standards and procedures (the EUR-ACE Framework Standards) while the Washington Accord relies on comparable accreditation procedures, independently applied by the participating agencies.

In most Washington Accord countries one degree is the academic basis for entry into the engineering profession, therefore, the Accord recognizes only the Bachelor degree. However, this scheme is at present being questioned and there are pressures for the Washington Accord to move toward a two-tier system analogous to the Bologna/EUR-ACE scheme. Indeed, the Engineering Council UK and Engineers Ireland (that are among the original signatories of the Washington Accord and also participate in the EUR-ACE systems) have accredited Master (SC) degrees for a number of years. Beginning in 2009/2010, ABET will also allow accreditation of engineering programmes provided by a higher education institutions (HEI) at two levels (Bachelor and Master).

The Washington Accord prescribes at least four years of study for an engineering Bachelor degree. In parallel, standards have been developed for three and two-year programmes, leading respectively to 'engineering technology' degrees and 'engineering technicians' qualifications that are recognized within the so called Sydney and Dublin Accords. The rigid and formal connection of outcomes with years of study and semantic definitions of technical professions in this three-accord (Washington - Sydney - Dublin) system, causes difficulties in the mutual professional recognition for programmes defined within the Bologna two-cycle scheme, as well as for the academic recognition of such programmes for graduates applying for admission to graduate studies.

Indeed, such problems should not exist in an outcomes approach. The assessment of certified learning outcomes and gained competences should be independent from the ways of their achievement and the time it takes. In this regard, the EUR-ACE Standards, consistent with the Bologna Process and the EQF, provide a more flexible connection between outcomes and duration of study than the Washington - Sydney - Dublin accords.

A comparison between the EUR-ACE and the Washington Accord requirements will be a crucial element in making the EUR-ACE label fully recognized globally, if for no other reason than that two members of the EUR-ACE core are also founding signatories of the Washington Accord. A comparative study is being promoted by ENAEE, and contacts have also been established with the International Engineering Alliance (IEA) that embraces the three Accords, in order to accomplish this aim.

7. Conclusions

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 no-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 (Augusti *et al*., 2008).

It is fair to state that the EUR-ACE system, compared with the Washington-Sydney-Dublin accord system is at the same time simpler and more flexible; 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 (Augusti, 2009).

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) of Dublin Descriptors, EQF and EU Directive on professional qualifications (Feyo, 2009). 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.

Acknowledgments

This paper is an updated and slightly revised version of a paper presented at the SEFI 2009 Annual Conference (Rotterdam, July 2009). The continuous support received from the DG "Education and Culture" of the European Commission through the projects EUR-ACE (2004-06), EUR-ACE IMPLEMENTATION (2006-08), PRO-EAST (2006-07) and EUR-ACE SPREAD (2008-10) is acknowledged. The author is also grateful to the many people, Institutions and Associations that have contributed to the EUR-ACE projects and are now collaborating with ENAEE, and in particular to Ian Freeston and Günter Heitmann for the many suggestions received while writing his papers.

Roma, 21 August 2009

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