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Origins, present status and perspectives of the European EUR-ACE engineering accreditation system

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In the EUR-ACE system a common European quality label (the EUR-ACE® label) is awarded to engineering education programmes accredited by a national Agency, under the condition that common Standards are satisfied. Nine Agencies are at present authorized to deliver the EUR-ACE® label. The history, development and future outlooks of EUR-ACE are summarized.

Key words: *accreditation, engineering programmes, quality assurance, qualification.*

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INTRODUCTION

The origins of the EUR-ACE accreditation system can be traced back to a series of Thematic Networks on Engineering Education supported by the European Commission (H3E, 1997-99; E4, 2000-04; TREE, 2004-08).

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). In 2004 ESOEPE[1] promoted a specific project (EUR-ACE - EURopean ACredited Engineer, 2004/06)[2] 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. In order to run this system, ESOEPE was transformed in 2006 into the international not-for-profit association "European Network for Accreditation of Engineering Education" (ENAEE).

The successive stages of EUR-ACE and ENAEE have been illustrated in several publications and Conference presentations [1-9]: this paper focuses on the latest and current developments, and on some outlooks for the future.

WHAT IS MEANT BY ACCREDITATION?

"Accreditation", a word not used in European Higher Education (HE) until the late 1990s, has rapidly become very frequent in European papers and documents, but with different meanings and definitions, even in the HE context. For example, the 2001 Communiqué of HE Ministers [10] considers "accreditation" as a 'possible mechanism of quality

[1] *The acronyms used in this paper, sometime defined when they first appear, are listed in an Appendix.*

[2] *A peculiarity of the EUR-ACE project was its support by both SOCRATES and TEMPUS EU programmes, so that the project could include partners from outside the EU, like the "Russian Association for Engineering Education" (RAEE, now AEER). RAEE became also a founding member of ENAEE.*

assurance' and the Communiqué of the 2003 Berlin Conference of Ministers of Education [11] stated that "by 2005 national quality assurance systems should include ... a system of accreditation, certification or comparable procedures".

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" [12-13]. "EUR-ACE accreditation" is essentially based on a peer review process, undertaken by appropriately trained and independent teams comprising experts from both academia and engineering practice, involving both scrutiny of data and structured visits to the HEI running the programme. The accreditation is referred to a specific engineering programme and not to Departments or Higher Education Institutions (HEIs), and ensures that the relevant programme has attained the standards required for its graduates to acquire the necessary educational qualifications to enter the engineering profession. However, this does not exclude and, on the contrary, is facilitated by an overall system of Quality Assurance (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" (CTI) established by a 1934 Law, and the "Engineering Council" (EngC), an organisation set up in the UK by Royal Charter in the 1980s to regulate the engineering profession and coordinate 36 UK Engineering Institutions, some of which date back to the 19-th century. Most of these national Engineering Accreditation Agencies, including CTI and EngC, were partners of the quoted EUR-ACE project: the "European Standards for the accreditation of engineering programmes" [12] were essentially compiled as a synthesis of their existing Standards.

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 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 standards, 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.
4. It can accommodate the development of new branches of engineering.

The first 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 countries. The current text, with very minor modifications, was approved in 2008 [12].

In accordance with the European Qualification Framework [14], the EUR-ACE Standards distinguish between First and Second Cycle degrees[3], and identify 21 outputs for accredited First Cycle

[3] *First Cycle and Second Cycle degrees are often referred to as "Bachelor" and "Master" respectively.*

(FC) degrees and 23 for Second Cycle (SC) 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 EUR-ACE Standards are consistent with the whole "Bologna Process", and in particular with the Dublin Descriptors [15], the Framework for Qualifications of the European Higher Education Area (in short European Qualification Framework, EQF) [14] and the Standards and Guidelines for Quality Assurance in the European Higher Education Area (in short European Standards and Guidelines, ESG) [16], and moreover take into account the EU Directive on the Recognition of Professional Qualifications [17]. Indeed, as discussed in [18], 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.

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. However, the Standards are also applicable to the accreditation of programmes leading directly to a Second Cycle Degree (conventionally termed "Integrated Programmes" or "Integrated Masters"), which constitute an important part of European engineering education, in particular 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, in some countries (and not in others) accreditation distinguishes between engineering branches (disciplines). 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 the 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.

THE EUR-ACE SYSTEM: INITIAL IMPLEMENTATION

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, hopefully leading in the near future to a formal multilateral recognition agreement. No supra-national Accreditation Board was ever proposed: accreditation is and will remain the task of national (or possibly regional) Agencies; the EUR-ACE® label is and will be a complement to the national accreditation. This decentralized approach appears to be rather peculiar 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 so-called "Bologna Process" is working towards the creation of a transparent system of easily readable and comparable degrees throughout the 47 countries of 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 motivation of the EUR-ACE system was and is to remedy to this deficiency.

In November 2006, ENAEE assessed that six Accreditation Agencies (the quoted CTI and EngC; the German ASIIN; Engineers Ireland; the Portuguese Ordem dos Engenheiros; RAEE, now AEER), all active partners of the EUR-ACE project, already fulfilled the requirements set by the Framework Standards and were authorized to award the EUR-ACE® label for a period of two years. Their authorization was renewed in 2008 after a rigorous re-assessment process including site visits by multi-agency teams.

Two 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 already in the first year (2007), although only three agencies (ASIIN, Engineers Ireland, RAEE) contributed.

SPREADING THE EUR-ACE SYSTEM

Although the six countries constituting in 2006-2008 the initial core of the EUR-ACE system were a significant sample of the EHEA, their number was only about one-seventh (1/7) of the total 47 EHEA countries. Therefore, ENAEE committed itself not only to strengthen the EUR-ACE system in the initial six countries, but also to spread it into other countries. In order to maintain the quality of the EUR-ACE system, rigorous conditions to be fulfilled and a detailed procedure to be followed to authorize an Agency to join the EUR-ACE system have been elaborated and collected in [19].

The effort to spread EUR-ACE into other countries, initially helped by an EC-supported project with the self-explanatory name of EUR-ACE SPREAD (2008-2010), is continuing today with appreciable success.

At the time of writing (May 2013) three more Agencies have been authorized to deliver the EUR-ACE® label, namely MÜDEK (TR), ARACIS (RO) and QUACING (IT), while KAUT (PL) and OAQ (CH) have obtained the status of "candidate Agency" and will probably be authorized in September. Note that ARACIS and OAQ are "general" QA Agencies, while previously only specialized "engineering" Agencies had been EUR-ACE-authorized.

Moreover, the "Finnish Higher Education Evaluation Council" (FINHEEC) has prepared the application to be EUR-ACE-authorized, that will be submitted within 2013. In Spain, the ENAEE member "Instituto de la Ingenieria de España" and the "National Agency for Quality Assessment and Accreditation" (ANECA) are soon to set up a body that can be EUR-ACE-authorized. The French-speaking Belgian HEIs will get the EUR-ACE® labels by CTI in the frame of an accord with the Belgian "Agence pour l'évaluation de la Qualité de l'Enseignement Supérieur" (AEQES).

When all these processes will be concluded (hopefully soon) the EUR-ACE system will still cover a minority of the EHEA countries (14 out of 47), but will be present in most European regions and in all the main European countries: a good point for further progress.

ENAEE is also active, either directly or through "experts", in the successive stages of the very ambitious OECD initiative "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" [20], that draws heavily from the EUR-ACE Framework Standards.

Another project that can eventually lead to a significant enhancement of EUR-ACE in Russia is the ECDEAST ("Engineering curriculum design aligned with the EQF and EUR-ACE Standards") project (2010-2013) [21], supported by the EC under the TEMPUS programmes, that has designed three 2-year Master curricula, compatible at the same time with European Frameworks (EUR-ACE and EQF) and with the Russian Federal State Educational Standards. Three corresponding programmes started in 2012 in three leading Russian HEIs (Bauman Moscow State Technical University; Saint Petersburg State Polytechnic University; Tomsk Polytechnic University) and passed a preliminary evaluation by a team of experts indicated by ENAEE and SEFI. The ECDEAST Final Conference has been held in Moscow on 4-6 June 2013.

THE GLOBAL CONTEXT

In principle, the EUR-ACE® label may also be awarded outside the EHEA: signals of interest for this possibility have already been heard from several sources (e.g. in 2010 the Institute of Engineering Education Taiwan invited the author of this paper to present the EUR-ACE system). A few EUR-ACE® labels have indeed been awarded (e.g. in China, Vietnam, Peru, Australia and in other countries not formally included in the EUR-ACE system) by EUR-ACE-authorized Agencies (namely ASIIN, CTI, AEER) that accredit also outside their home country.

Thus ENAEE, although focussing obviously its attention on Europe, has taken some initiatives on the global scene. The most relevant is the TEMPUS project "Quality of Engineering Education in Central Asia" (QUEECA; 2012-2015) that has the declared objective of promoting and implementing in Central Asia countries (namely Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan) a system of QA and accreditation of EE analogous to EUR-ACE.

But the main actor to confront the global scene is the Washington Accord (WA), 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), joined over the years by other countries ("jurisdictions", as they are called in WA documents): at present, full members of the WA are agencies operating in USA (ABET), UK, Ireland, Canada, Australia, New Zealand, South Africa, Japan, Hong Kong China, Chinese Taipei, Korea, Turkey, Russia. Four of the nine EUR-ACE-authorized Agencies are members of the WA, namely EngC, Engineers Ireland, MÜDEK and AEER.

The WA 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. The WA has analogies with the EUR-ACE system: however, the latter awards a common label based on shared standards and procedures (the EUR-ACE Framework Standards) while the WA relies on comparable accreditation procedures, independently applied by the participating agencies.

In most WA jurisdictions one degree (Bachelor) is the academic basis for entry into the engineering profession: therefore, the WA recognizes only the Bachelor degree, for which at least four years of study are prescribed. 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 three Accords are coordinated by the International Engineering Alliance (IEA).

The rigid and formal definitions of technical professions and their connection with the durations of the studies of the IEA system, cause difficulties in the mutual professional recognition for programmes defined within the Bologna

scheme, as well as for the academic recognition of the degrees 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 dialogue on these questions is open between ENAEE and IEA, and representatives of either side participate in the respective meetings. Full understanding of the problems is indeed a prerequisite for their solution.

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 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 greatly facilitate job mobility [7].

It is fair to state that EUR-ACE, 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", that 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 [6].

Another point worth noting is the distinction existing in several countries (including Russia) between the required official "accreditation" (often called "state accreditation": but in accordance with international usage it should rather be called "licensing" or "authorization") and the EUR-ACE accreditation defined in Section 1. This dual system is e.g. in force in Poland, where the first, obligatory type of accreditation is implemented by the State Accreditation Committee (PKA), an institution established and financed by the Minister of Higher Education, and the second type is a voluntary accreditation implemented (in parallel to other authorized institutions and organisations in other specific subject areas) by the "Accreditation Commission of Universities of Technology" (KAUT) and regarded as a true recognition of "quality", while the PKA accreditation is often seen as a mere bureaucratic burden.

But, apart from technical and operational difficulties, a pan-European scheme like the EUR-ACE 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: MAIN ACRONYMS USED IN THE PAPER

EUR-ACE:	EURopean ACredited Engineer
ENAEE:	European Network for Accreditation of Engineering Education
ESOEPE:	European Standing Observatory for the Engineering Profession and Education
HE:	Higher Education
HEI:	HE Institution (e.g. University)
EC:	European Commission
EU:	European Union
EHEA:	European Higher Education Area
WA:	Washington Accord
IEA:	International Engineering Alliance
EE:	Engineering Education
QA:	Quality Assurance
EQF:	European Qualification Framework
FC:	First Cycle (FCD: First cycle degree)
SC:	Second Cycle (SCD: Second Cycle degree)
AEER:	Association for Engineering Education of Russia
(formerly: RAEE:	Russian Association for Engineering Education)
ARACIS:	Romanian Agency for Quality Assurance in Higher Education
ASIIN:	Accreditation Agency for Degree Programmes in Engineering, Informatics, the Natural Sciences and Mathematics (DE)
CTI:	Commission des Titre d' Ingénieur (FR)
EngC:	Engineering Council (UK)
FINHEEC:	Finnish Higher Education Evaluation Council
KAUT:	Accreditation Commission of Universities of Technology [Komisja Akredytacyjna Uczelni Technicznych]
MÜDEK:	(Turkish) Association for Evaluation and Accreditation of Engineering Programs
OAQ:	Swiss Center of Accreditation and Quality Assurance in Higher Education [Organ für Akkreditierung und Qualitätssicherung der Schweizerischen Hochschulen]
QUACING:	(Italian) Agency for QA and EUR-ACE accreditation of engineering programmes