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Professional-Public Accreditation of Engineering Educational Programs

Editorial board

DEAR READERS!

The current issue explores the procedure of professional and public accreditation of engineering educational programs in Russia and abroad. Our foreign partners share their experience in engineering educational program accreditation in Turkey, Italy, the USA and France. Russian authors represent the universities of Saint-Petersburg, Tomsk, Penza, Novosibirsk and Krasnoyarsk.

High quality of engineering education is one of the important factors that contribute to sustainable economic development. At the same time, Russia is presently experiencing a great shortage of specialists capable of generating, developing and implementing competitive engineering solutions. Inadequacy of engineering training quality and employers' needs gives rise to engineering problems and requires additional efforts not only for engineering curriculum and training method revision, but also for the enhancement of engineering education quality control system. Professional-public accreditation of engineering educational programs and professional certification are proved to be effective tools for engineering education quality assurance in the developed countries.

Such tools have been successfully applied in a number of developed countries, such as the USA, Japan, Great Britain, Singapore, South Korea, most European countries and other countries all over the world, for many years. The organizations and professional associations providing independent and voluntary educational program accreditation and professional certification are recognized and supported by government, employers and academic community. The activity of the above-mentioned accrediting bodies allows employers and representatives of academic and professional communities to actively participate both in design and implementation of engineering educational programs and training quality control. The existing international alliances (IEA, Washington Accord, ENAEE, APEC, FEANI, EMF) insure international recognition of educational programs and engineering qualifications by means of mutually approved accreditation and certification criteria and procedures.

In Russia, the system of professional-public independent accreditation of engineering educational programs established by Association of Engineering Education in Russia (AEER) has been successfully at work for more than 10 years. AEER is a member of such alliances as: WA (Washington Accord), ENAEE – European Network for Accreditation of Engineering Education, IPEA – International Professional Engineers Agreement, APEC Engineer Register. Therefore, the criteria and procedures applied by AEER for engineering educational program accreditation are recognized by the signatory countries of these agreements (more than 25 countries). For the last years AEER has accredited more than 220 educational programs in 30 Russian and 7 Kazakhstan Universities. 141 of them were awarded with the international recognition label of ENAEE.

Apart from AEER, there are AKKORK (the Agency for Higher Education Quality Assurance and Career Development) and industrial associations of employers that accredit engineering educational programs in Russia.

The development of professional-public accreditation of engineering programs in Russia faces a number of challenges, the most crucial of which is a weak motivation of Universities for independent accreditation. Unfortunately, the Federal Law "On Education" (in particular article 96) passed by the State Duma of the RF in December 2012 doesn't encourage the universities to submit their programs for independent professional-public accreditation and raises contradictions in the law interpretation. That became the reason for public hearings held in St. Petersburg in May, 2013, which were initiated by AEER, National Research Polytechnic Universities of Tomsk and St. Petersburg. The proposals and recommendations approved at the hearings are published in the present issue. The Editorial Board relies on positive response of the organizations and bodies for which these proposals are addressed.

The articles published in the issue provide valuable information for engineering organizations, academic and professional communities to better understand the results and procedure of public-professional accreditation of engineering educational programs.

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ABET's Global Engagement*

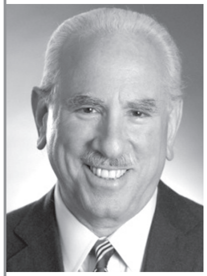
ABET (Accreditation Board for Engineering and Technology), USA
M.K.J. Milligan, D. Iacona, J.L. Sussman

This paper will discuss ABET's global activities in detail, with an emphasis on the accreditation of programs outside the US and the Washington Accord, and how these activities contribute to the quality improvement of engineering education around the world, and its impact on engineering education, and the profession.

Key words: *ABET, engineering education, technical education, international education, accreditation, Washington Accord.*

M.K.J. Milligan

D. Iacona



J.L. Sussman

Introduction

Over its 80-year history, ABET, a federation of 32 professional and technical societies, has been the recognized accreditor of applied science, computing, engineering, and engineering technology programs in the United States. ABET's global engagement through its mutual recognition agreements (MRAs), memoranda of understanding (MOUs), and in the last five years, through direct accreditation of programs outside the US, has solidified ABET's vision to be "recognized as the worldwide leader in assuring quality and stimulating innovation in applied science, computing, engineering, and engineering technology education" [1].

It is especially important for engineering educators to understand the global engagement of ABET, and the impact it may have on the engineering profession, and education. As the world economy becomes more integrated, graduates from accredited programs (both ABET and MRA partner organizations) will enter the workforce, and work in a very dynamic global environment. Engineers will cross geographic borders frequently, seeking professional licensure, graduate education and employment in a number of countries. ABET's global presence will significantly help them be successful.

This paper aims to educate the reader on ABET's various global activities and how they contribute to the advancement of technical education.

Mutual Recognition Agreements (MRAs)

MRAs are international agreements signed amongst accrediting bodies responsible for the accreditation of technical education in their respective jurisdictions. These MRAs recognize the substantial equivalence of accreditation systems, and in turn, recognize the substantial equivalence of programs accredited by the signatories of the agreement. Substantial equivalence implies that the accreditation systems have comparable-although not identical-processes, criteria, and outcomes. Substantial equivalence serves as an indicator of the graduates' preparedness to begin

* *This paper was presented at the ASEE 2013 Annual Conference & Exposition in Atlanta, Georgia, USA on June 26th, 2013.*

practice in the professions. Currently, ABET is engaged in four MRAs.

Signed between ABET and the Canadian Council of Professional Engineers (now Engineers Canada) in 1980, this first bi-lateral MRA for engineering set the precedent for the establishment of the Washington Accord, the multi-lateral MRA for engineering, nine years later.

The Sydney Accord, the MRA for engineering technologists, was established in 2001 and ABET was admitted as a full signatory in 2009. Today, the Washington & Sydney Accords fall under an umbrella organization known as the International Engineering Alliance (IEA), which also includes the Dublin Accord (MRA for two-year technician programs), the International Professional Engineers Agreement (IntPE), the International Engineering Technologist Agreement (IntET), and the Asia Pacific Economic Cooperation (APEC Engineer). It is important to note that the three Accords relate to the educational base of engineers, engineering technologists, and engineering technicians, respectively. The IntPE, IntET, and APEC Engineers focus on the professional competence and mobility of technical professionals in the fields of engineering and engineering technology. ABET, however, is not a member of any of the mobility agreements. The US representative to the IntPE is the National Council of Examiners for Engineering and Surveying (NCEES).

The Seoul Accord, established in 2009 with ABET as a founding signatory, is the multi-lateral MRA for computing. Current members include ABET, Accreditation Board for Engineering Education of Korea (ABEEK), Australian Computer Society (ACS), British Computer Society (BCS), Canadian Information Processing Society (CIPS), Honk Kong Institute of Engineers (HKIE), Institution of Engineering Education Taiwan (IEET) and Japan Accreditation Board for Engineering Education (JABEE).

The multi-lateral Washington Accord was signed in 1989 by six founding signatories representing the US (ABET), UK, Canada, Australia, Ireland, and New Zealand. Its membership has since grown to include 15 full signatories and five members under provisional status:

Full Signatories

1. Engineers Australia [1989].
2. Engineers Canada [1989].
3. Institute of Engineering Education Taiwan (IEET) [2007].
4. Hong Kong Institution of Engineers (HKIE) [1995].
5. Engineers Ireland [1989].
6. Japan Accreditation Board for Engineering Education (JABEE) [2005].
7. Accreditation Board for Engineering Education of Korea (ABEEK) [2007].
8. Board of Engineers Malaysia (BEM) [2009].
9. Institution of Professional Engineers New Zealand (IPENZ) [1989].
10. Association for Engineering Education of Russia (AEER) [2012].
11. Institution of Engineers Singapore (IES) [2006].
12. Engineering Council of South Africa (ECSA) [1999].
13. MUDEK – Turkey [2011].
14. Engineering Council UK (ECUK) [1989].
15. ABET – US [1989].

Members under Provisional Status

1. Board of Accreditation for Engineering and Technical Education – Bangladesh (BAETE).
2. German Accreditation Agency for Study Programs in Engineering and Informatics (ASIIN).
3. National Board of Accreditation of the All India Council for Technical Education (NBA).
4. Pakistan Engineering Council (PEC).
5. Institution of Engineers Sri Lanka (IESL).

Members under provisional status are accrediting organizations that are interested in obtaining full signatory status, but whose accreditation systems are not yet considered to be substantially equivalent to that of full signatories. During the period of provisional status, the accreditation system and programs accredited by that system are not recognized as substantially equivalent. Recognition begins once an organization has been admitted as a full signatory.

Engineering Criteria 2000 (EC2000), the outcomes-based accreditation model adopted by ABET in 1996 was introduced to the Washington Accord in 2001. Since then, many signatories have adopted an outcomes-based accreditation model. The outcome-based accreditation model focuses on outputs (what students learn) rather than input (what they are taught) [2]. Commissioned by ABET in 2002, the Center for the Study of Higher Education at Pennsylvania State University conducted a study to determine the impact EC2000. The study, which was conducted over a three-and-a-half-year period, resulted in several key findings:

- Greater emphasis is placed on professional skills and active learning; there is high level of faculty support for continuous improvement.
- 2004 graduates are better prepared to enter the profession than their 1994 counterparts.
- Graduates have gained professional skills while maintaining their technical skills.
- Changes in program and student experiences are empirically linked to higher performance [3].

The Washington Accord has since developed a set of graduate attributes exemplars. As defined in the IEA's Graduate Attribute and Professional Competencies document, "Graduate Attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practise at the appropriate level. The graduate attributes are exemplars of the attributes expected of graduates from an accredited programme. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary by a range indication appropriate to the type of programme" [4].

In addition to identifying and defining attributes expected of graduates of accredited programs, the graduate attributes are also intended to help signatories and provisional members develop outcomes-based accreditation systems and criteria. Outcomes-based accreditation focuses on what the students learn as a result of matriculating through the program, as opposed to focusing on what they are being taught. Some of the signatories of the Washington Accord, including ABET, have already adopted an outcomes-based accreditation system.

In the United States, the accreditation of engineering programs and the licensing of professional engineers are conducted by separate bodies. ABET accredits engineering programs while each of the 54 state licensing boards for professional engineers are responsible for licensure within their respective jurisdictions. ABET recognizes engineering programs accredited by other Washington Accord signatories as being substantially equivalent to ABET accredited engineering programs, and encourages state licensing boards to do the same, however, results are mixed: some state licensing boards recognize the Washington Accord, some do not recognize the Washington Accord at all, while others will only accept programs accredited by the six founding signatories. ABET will remain committed to educating the state licensing boards in an effort to increase Washington Accord recognition.

ABET's participation in these MRAs assures employers that the educational base of graduates of Accord recognized programs has adequately prepared them to begin practice in the profession. Similarly, it assures educators/administrators that graduates of Accord recognized programs wishing to further their education have the appropriate educational base.

Memoranda of Understanding (MOU)

While MRAs focus on the recognition of accreditation systems, MOUs are designed to facilitate collaboration between and among accrediting organizations. Approval from the ABET Board of Directors is necessary prior to engaging in a MOU. ABET is currently engaged in 16 MOUs with national and regional accreditors/organizations of technical education in the following countries/regions: Argentina, Portugal, Spain, Germany, Japan, Taiwan, Greater Caribbean, Central America, Western Hemisphere (Mexico and Canada), Egypt, Chile, Peru, UNESCO (Latin America and Caribbean), Israel, South Korea, and France.

In addition to exchanging information on best practices, most organizations sign a MOU with ABET with the intent of seeking assistance in further developing their accreditation systems. This is accomplished in a number of ways, depending on the specific maturity and needs of the accreditation system. Services provided by ABET typically include "sharing of its experience in the field of accreditation, general information on its policies and procedures, criteria development seminars, evaluator training, observer visits, and other related activities" [5].

MOUs are also beneficial to ABET in that they provide valuable information regarding the local accreditation practices and current state of technical education in other countries and regions of the world. ABET will continue to work with other quality assurance organizations with the intent of improving the quality of technical education worldwide.

Accreditation outside the US

Until 2007, ABET did not accredit programs outside of the U.S., but rather performed "substantial equivalency evaluations". These evaluations were conducted in much the same manner as accreditation evaluations, but did not confer the same status as an accredited program. In response to a significant increased demand for ABET accreditation outside the US, and to support a broader goal of increasing the quality of global technical education, the ABET Board of Directors approved accreditation outside of the U.S. in 2006. With the introduction of global accreditation activities, ABET began to phase out its substantial equivalency evaluations, but will continue to confer recognition of those programs already deemed substantially equivalent. ABET's extensive experience with substantial equivalency reviews over a 25-year period has adequately prepared it for accreditation of programs outside the US.

To qualify for ABET accreditation, "programs outside of the U.S. seeking accreditation must have each appropriate education authority, recognition, or accreditation agency complete a Request for Approval form to be submitted with the formal Request for Evaluation. ABET will conduct an accreditation review outside the U.S. only with explicit permission from all applicable national education authorities in that program's country or region" [6].

Within the past five years, ABET has accredited 324 programs at 64 institutions in 23 countries outside the US: Bahrain, Egypt, Jordan, Saudi Arabia, Kuwait, Lebanon, Oman, Qatar, Turkey, United Arab Emirates, Kazakhstan, Morocco, Mexico, Chile, Colombia, Peru, India, Indonesia, Philippines, Singapore, Germany, Spain, and South Africa. The demand for ABET accreditation remains high, as the value of ABET accreditation to the program is seen to be multidimensional. Not only does ABET accreditation assure the quality of the program and its quality improvement system, it also allows programs to be viewed as competitive with local and international institutions, and provides industry a global source of qualified graduates from which to hire. In addition, programs often use their accredited status to recruit students, and to seek international recognition of their programs and graduates.

Academic programs outside the US are reviewed using the same accreditation policies, procedures, and outcomes-based criteria used to review programs within the U.S. In 2000, ABET adopted outcomes-based accreditation criteria, divided into two sets: general criteria and program-specific criteria. The general criteria apply to all programs, and contain the majority of requirements that must be met. Program criteria apply only to specific programs, and contain areas of additional knowledge and skills critical to the particular program of study. For example, a Civil Engineering program will be reviewed against the general criteria and the Civil Engineering program criteria. In cases where program criteria for a specific program do not exist, the program is reviewed against the general criteria only. To receive ABET accreditation programs must demonstrate that they meet all general and all applicable program criteria.

As a means to educate university faculty and administrators on the assessment process, ABET offers several resources. One-day Program Assessment Workshops (PAWs), are designed to broaden the participants' "understanding of the continuous improvement of student learning through the design of assessment processes, development of measurable learning outcomes, and application of data collection and data reporting methods" [7]. PAWs benefit faculty members and administrators and can be offered outside the US upon request.

The four-day Institute for the Development of Excellence in Assessment Leadership (IDEAL) is designed for individuals responsible for leading their faculty in the development and implementation of a program assessment plan. IDEAL equips its participants with the skills and knowledge needed to become an effective assessment leader. Typically, IDEAL is offered in the US. However, upon request, a slightly modified and shortened version of IDEAL can be offered internationally.

The annual ABET Symposium, featuring over 70 sessions, is the leading event for assessment, accreditation, and innovation of technical education. The ABET Symposium is only held in the US, however, we encourage participation of our international constituents and peers. ABET also offers a series of free webinars focusing on a range of topics. These can be found on the official ABET website.

With globalization and the expansion of multinational corporations, ABET accreditation provides employers, licensing bodies, and universities with "proof that a collegiate program has met certain standards necessary to produce graduates who are ready to enter their professions." [8]. It also ensures that "students who graduate from accredited programs have access to enhanced opportunities in employment; licensure, registration and certification; graduate education and global mobility" [8].

Other International Activities

As a means to become further engaged in the global community of engineering education, ABET became a member of both the Global Engineering Deans Council (GEDC) and the International Federation of Engineering Education Societies (IFEES) in 2011.

The GEDC, modeled after the ASEE Engineering Deans Council, was established in 2008 with the mission "to serve as a global network of engineering deans, and to leverage on the collective strengths, for the advancement of engineering education and research"[9]. The GEDC membership currently consists of approximately 75 deans representing 25 countries.

IFEES was founded in 2006 with the mission to "provide a global network of engineering education stakeholders which leverages the collective resources of its members to fulfill their missions by identifying, discussing, and advancing common objectives of the engineering education community to meet the global challenges" [10].

Membership to these global organizations has provided a platform for ABET to communicate directly with representatives of its global constituencies and learn more about their needs, challenges, and successes with respect to quality assurance, innovation, and engineering education. This platform provides ABET another mechanism to promote and contribute to engineering education.

Conclusion

The global activities described in this paper serve as mechanisms in fulfilling ABET's mission of serving "...the public globally through the promotion and advancement of education in applied science, computing, engineering, and engineering technology" [1]. To further advance its mission, ABET will continue to actively engage in global activities focused on improving the quality of technical education.

REFERENCES

1. ABET Vision and Mission [Electronic resource] // ABET: the offic. site. – Baltimore, 2011. – URL: http://www.abet.org/vision-mission/, free. – Tit. from the screen (usage date: 20.03.2013).
2. Phillips Winfred M. Quality assurance for engineering education in a changing world / Winfred M. Phillips, George D. Peterson, Kathryn B. Aberle // Int. J. Eng. Educ. – 2000. – Vol. 16, N 3. – P. 97–103.
3. Lattuca Lisa R. Engineering change: a study of the impact of EC2000: execut. summary / Lisa R. Lattuca, Patrich T. Terenzini, J. Fredricks Volkwein. – Baltimore: ABET, Inc., 2006. – P. 1–9.
4. Graduate attributes and professional competencies [Electronic resource] / Int. Eng. Alliance. – Vers. 3, 21 June 2013. – [Wellington, 2013]. – P. 2. – URL: http://www.ieagreements.org/IEA-Grad-Attr-Prof-Competencies.pdf, free. – Tit. from the tit. screen (usage date: 22.07.2013).
5. Guidelines for establishing Memoranda of Understanding (MOUs) [Electronic resource] // ABET: the offic. site. – Baltimore, cop. 2011. – URL: http://www.abet.org/guidelines-to-establish-memoranda-of-understanding, free. – Tit. from the screen (usage date: 20.03.2013).
6. Accreditation outside of the U.S. [Electronic resource] // ABET: the offic. site. – Baltimore, cop. 2011. – URL: http://www.abet.org/accreditation-outside-us/, free. – Tit. from the screen (usage date: 20.03.2013).
7. Program assessment workshops [Electronic resource] // Ibid. – URL: http://www.abet.org/program-assessment-workshops/, free. – Tit. from the screen (usage date: 20.03.2013).
8. Why accreditation matters [Electronic resource] // Ibid. – URL: http://www.abet.org/why-accreditation-matters/, free. – Tit. from the screen (usage date: 20.03.2013).
9. About GEDC [Electronic resource] // GEDC: The Global Eng. Deans Council [offic. site]. – [S. l., 2013]. – URL: http://www.gedcouncil.org/about-gedc, free. – Tit. from the screen (usage date: 20.03.2013).
10. 2011 IFEES strategic plan [Electronic resource]. – [S. l., 2011]. – 5 p. – URL: http://www.sefi.be/ifees/wp-content/uploads/2011-04-18-Strategic-Plan-Rev-9.pdf, free. – Tit. from the tit. screen (usage date: 20.03.2013).

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European perspectives on the competences of engineering graduates

Commission of certified engineers (CTI), France
B. Remaud

The input-based approach to engineering education, which was the rule during the last century, is being replaced by the ouput-based approach for the design of the programmes as well as for their accreditation. In many institutions, the competences description seems close to a layer over the traditional pedagogical approaches; in particular, the definition and the assessment of the transferable skills are diversely implemented. We present and discuss the state of art in the French engineering education, and a survey to study the impact of these new approaches on the young engineers.

Key words: *Engineering education, competences specification and assessment, impact on graduate engineers.*

B. Remaud

Introduction

In the nineteenth century, a model of university emerged in Europe, it is often referred to as the Von Humboldt model, because this famous geographer was its most prominent promoter. The concept of « Humboldtian » university used today agglomerates several elements including the following (see S. Paletschek [1]):

- the unity of research and teaching;
- the function of the university as a research institution;
- the freedom of research and teaching which allows the university to function in furthering pure science (which is to say a science free of vested interests);
- the assumption that science provides moral education.

The university in this context relies on a faculty staff dedicated "without compromise" to pure science and personal culture, "the teacher is not there to serve the student, but both must serve the research of knowledge" [2].

In contrast, the model of a university which is dedicated to social progress and applied knowledge has been promoted by E.N. Whitehead in 1929 (see ref.11).

But the culture of a university dedicated to knowledge and free of any constraint seems deeply rooted in the faculty of many universities in Europe: academic freedom is often invoked, the research of consensus within the faculty is the rule, the outside world (enterprises, local and national authorities) is barely associated with the governance of colleges and universities; the concern for academic excellence for training is raised to its highest level (including the training of engineers).

The vision of the university currently supported in Europe seems almost the antithesis of the Humboldtian vision. In a recent report [3] of the European Commission "Rethinking Education - Investing in Skills for better socio-economic outcomes", it is written that "investment in education and training for skills development is essential to boost growth and competitiveness, skills determine Europe's capacity to increase productivity". And further "European education and training systems are not working adequately with business or employers to bring leaning experience closer to reality of the working environment".

The Commission gives four axes of efforts to improve the situation (for all education cycles education, not only for the universities):

- Developing world-class vocational education and training to raise the quality of vocational skills.
- Promoting work based learning including quality traineeships, apprenticeships and dual learning models to help the transition from learning to work.
- Promoting partnerships between public and private institutions (to ensure appropriate curricula and skills provision).
- Promoting mobility through the proposed Erasmus programme for All.

Engineering departments (or applied sciences departments) in Europe must mediate between the demands of their academic missions and their missions concerning the employability of their graduates, their contribution to the national economic development and their contribution to solve global problems that the world has to face in the future.

Depending on the academic traditions and the political contexts in their respective countries, engineering departments have different ways to arbitrate between the two extremes: on the one hand, an engineering course based on scientific excellence -including research- to educate, critical and responsible individuals, who have to define after their studies their career path; on the other hand, training of scientists for business, having a solid scientific basis but also trained for their future responsibilities.

Within this diversity, however, trends are emerging at the global level. These trends are the result of underlying constraints such as the globalization of the world economy, the globalization of environmental problems, the student and graduate mobility (professional mobility throughout life and geographical mobility).

These trends lead in all countries to training of engineers, less expert in a specific field, but open to cultural diversity and more likely to consider the problems in their entirety (technical, but economic and societal).

In this context - as is natural in a worldwide market- setting standards and guidelines becomes mandatory to facilitate international transparency of courses (not their homogenization), to establish the comparability of objectives and of learning outcomes for the graduates.

Competences of graduate engineers and Quality Assurance

"Competences" and "Quality Assurance" are general keywords which are sometimes interpreted differently, depending on the context; we use the definitions by ENQA [4].

Competences represent a dynamic combination of knowledge, understanding, skills and abilities. Competences are developed and acquired by the students during the educational process. Some competences are subject-area related (specific to a field of study), others are generic (common to any study programme).

The concept of competence is associated with the concept of learning outcomes, which are statements – made by the academic staff – of what a learner is expected to know, understand and/or be able to demonstrate after completion of a process of learning. Learning outcomes have to be expressed in terms of the level of competence (knowledge, understanding, skills and abilities) to be obtained by the learner

Finally, "quality assurance" refers to a "continuous process of evaluating the quality of a system, an institution or a program of higher education." Quality assurance, as a process, focuses on both accountability and continuous improvement by providing information and judgements (no ranking) through defined processes and pre-agreed criteria.

In a very comprehensive report, OECD [5] has published a global cross-sectional analysis of learning outcomes for engineers, in particular, to extract common elements recognized at the international level. The report provides a comparative analysis of the EUR-ACE standards [6] and ABET [7]; beyond differences in wording, sometimes differences of emphasis, there is a broad consensus around six themes:

- Knowledge and Understanding for the bases in mathematics and science underlying all engineers training; EUR-ACE includes the need for forefront knowledge in a leading sector and for transdisciplinarity.

- Engineering Analysis: refers to the ability to apply knowledge to the resolution (identification, formulation, resolution) of engineering problems (products, processes and methods).
- Engineering Design: is the ability to solve problems in satisfying the constraints; ABET specifies the constraints (economic, environmental, social, political, ethical, health and safety).
- Investigations: only specified by EUR-ACE, refers to the ability to conduct searches of literature, and to use data bases and other sources of information.
- Engineering Practice: refers to the ability of the theoretical and experimental tools for solving problems, be aware of their limitations and their implications for non-technical (EUR-ACE) or understand their ethical and professional (ABET).
- Transferable Skills: concerns a wide domain, where are the capacities or abilities to function effectively as an individual and as a member of a team; to use diverse methods to communicate effectively with the engineering community and with society at large; to demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice; to demonstrate awareness of project management and business practices; to engage in independent life-long learning.

The "learning outcomes" are results-oriented; the quality assurance is more process-oriented, it aims to organizing the continuous improvement of programmes and of institutions (and of the accreditation agencies) and to provide the foundation for mutual trust between institutions of different countries.

Impact on academia and institutions

The switch from a program-based to a learning outcomes-based approach of engineering education has deep consequences for the university teachers and for the management of the universities and their departments.

This new approach is like a Copernican revolution for teachers, a shift that is a source of concern or of resistance to change. The programmes do not result from the concatenation of the professors' specialities, but from a global project where the learning outcomes are determined to prepare graduates to their professional career.

Quality assurance, with its feedback loop for continuous improvement, requires a participatory but strong governance for the institution. A quality assurance process should be based on a broad consensus within the institution, everybody sharing the objectives and methods. But the improvements may not result from the simple addition of individual goodwill; choices -sometimes painful for someone-, must be made by a legitimate and informed authority.

In many countries, the universities are managed by large assemblies where all the bodies are represented (especially teachers, students most often, technical and administrative staff sometimes). This model seems hardly compatible with the accepted global guidelines for the education of engineers: the definition of the targeted competencies, the acquisition of non-technical skills, the training in engineering fields, cannot be conceived without a wide opening of the institutions and programmes to representatives of society (employers, local authorities, government).

For example, the recent release of European Ministers of the EHEA (Bucharest 2012) gives one of the priorities for 2012-2015: "working to improve employability, learning throughout life, the ability to problem solving, entrepreneurial skills, through enhanced cooperation with employers, especially for the development of training programs". This recommendation applies to all university domains; it has a particular resonance for the training of engineers.

Although, there is a global agreement on the principles of QA and competences approach, their concrete implementation is highly variable depending on the countries and on the institutions. Programme managers need to arbitrate between multiple constraints:

- Share of training time between scientific matters and transferable skills.
- Arbitration between the objective of academic excellence in a domain (each professor is convinced that his/her domain is at the forefront) and

the training to broad multidisciplinary domains.

- Arbitration between traditional pedagogical methods (courses, exercises, laboratory work) and other active methods (pedagogy by project, use of new technologies, team work, internship, international mobility, etc.)
- Organization of the interventions in the curriculum by specialists from industry and business.
- Insertion within the limited time of the curriculum of experiences in the workplace and of international mobility.

Impact on the French graduate engineers

One may consider that the quality assurance and the competence approach constitute a new paradigm for the engineering education. After more than 10 years of experience, one may question its impact (see for example ref. 8) on the graduates and on the institutions; more precisely:

- What is the impact on student learning outcomes in accredited programmes and institutions?
- What is the impact on organizational and educational policies and practices that may have led to improved student learning outcomes?

It is difficult to disentangle all the sources of evolution, however after a thorough study the ABET report (2006) [8] concludes: "The weight of the accumulated evidence collected for Engineering Change indicates clearly that the implementation of the EC2000 accreditation criteria has had a positive, and sometimes substantial, impact on engineering programs, student experiences, and student learning".

In France, IESF (Association of French engineers and scientists) performs regular surveys [9] of engineers in activity, with more than 50 000 answers. In connection with CTI (Commission des Titres d'ingénieur), the graduate engineers are questioned about their opinion on the learning outcomes as defined by CTI: first, they rate their importance in their professional life, second they rate the quality of their training by their institution.

In Table 1, are reported the results for young (below 30) professional engineers in 2008 and 2012 (period during which CTI has put a strong emphasis on QA's and LO's).

The ranking by order of importance is meaningful by itself: the French young engineers estimate that professional and specialized competences are of the utmost importance as well as the "transferable skills"; however they feel as less important the societal values and the ability for research.

If one compares the two surveys, a remarkable steadiness is observed for all competences, only two vary significantly: a net increase for the competence linked to the speciality and a net decrease for the societal values. Both evolutions are coherent but somewhat surprising, since one would expect a larger awareness to environmental issues from young generations.

Table 2 shows a very significant and coherent positive evolution of the young engineers' appreciation on their training. The progress concerns all competences and particularly the integration in professional life, the capacity to work in an international context, the account of societal issues; are noticeable too the preparation to innovation and research.

Table 1.

Percentage of French engineers below 30 who consider the competence as important for their professional life (on a scale : important, fair, not important)			
	2008	2012	Changes
Awareness of societal values such as sustainable development, social relations	40 %	34 %	-6 %
Ability to innovate and to undertake research	55 %	56 %	+1 %
Ability to work in an international context	61 %	61 %	0
Capacity to account for industrial, economic and professional issues	65 %	66 %	+1 %
Knowledge and understanding of a wide field of basic sciences	65 %	64 %	-1 %
Ability to make career choices and to integrate into professional life	68 %	66 %	-2 %
Ability to mobilize knowledge in your speciality	71 %	79 %	+8 %
Command of methods and tools for the engineer	74 %	77 %	+3 %
Ability to integrate into an organization, to animate and to improve it	81 %	84 %	+3 %

Table 2.

Percentage of French engineers below 30 who consider as good their initial training for the following competences (on a scale : good, fair, not good)			
	2008	2012	Changes
Awareness of societal values such as sustainable development, social relations	24 %	36 %	+12 %
Ability to innovate and to undertake research	47 %	57 %	+10 %
Ability to work in an international context	40 %	52 %	+12 %
Capacity to account for industrial, economic and professional issues	30 %	41 %	+11 %
Knowledge and understanding of a wide field of basic sciences	76 %	83 %	+7 %
Ability to make career choices and to integrate into professional life	33 %	45 %	+12 %
Ability to mobilize knowledge in your speciality	73 %	80 %	+7 %
Command of methods and tools for the engineer	66 %	75 %	+9 %
Ability to integrate into an organization, to animate and to improve it	48 %	50 %	+2 %

This evolution has to be put in correlation with CTI's policy: mandatory 28 weeks internship (with at least 14 in a company), 80% at least of the students with an international mobility (3 months or more), fluency in English certified by an external agency and the obligation to offer to each student access to a third language; obligation for the private institutions to have a significant part of their faculty involved in academic research, etc.

At least, in Table 3 are singled out the competences for which there is a large discrepancy between their importance in professional life and the quality of their training. There is a strong correlation for all but four competences: the young engineers have a very good opinion of their training in basic sciences, although they feel that it is not the most important competence they need in their profession.

Table 3.

Opinion of the French engineers below 30 about the engineer competences (2012)			
	Important for profession	Well trained	Differences
Awareness of societal values such as sustainable development, social relations	34 %	36 %	+2 %
Ability to innovate and to undertake research	56 %	57 %	+1 %
Ability to work in an international context	61 %	52 %	- 9 %
Capacity to account for industrial, economic and professional issues	66 %	41 %	-25 %
Knowledge and understanding of a wide field of basic sciences	64 %	83 %	+19 %
Ability to make career choices and to integrate into professional life	66 %	45 %	-21 %
Ability to mobilize knowledge in your speciality	79 %	80 %	+1 %
Command of methods and tools for the engineer	77 %	75 %	-2 %
Ability to integrate into an organization, to animate and to improve it	48 %	50 %	+2 %

On the contrary, they consider as unsatisfying their training to account for industrial, economic and professional issues; at a lesser degree they have the same opinion for their preparation to professional life and their training to work in an international context.

These results are taken into account by CTI in its standards and guidelines; the young engineers' dissatisfaction regarding their training to the soft skills has to be moderated, since the education has to prepare the students to their profession not to supply the employers with ready-to-use engineers. During their first years as employees, the "junior" engineers complete their training in particular in the soft skills.

But the share between which has to be trained during the studies and which is left to the junior period in the company, constitutes an open question and has to be discussed between the representatives of the institutions and of the employers.

Open questions and perspectives

During the last decade, engineering education has dramatically changed; however the process is still in midstream, institutions need a lot of efforts to durably implement the QA and LO approaches in their curricula. Many workshops are organized to discuss the details of the process which leads from the competence profile definition to the detailed study programme.

But the main open question concerns the potential gap between the intended (as described by the institution) and the achieved (by the student) learning outcomes. The faculty professors are used to assess the level of scientific and technical knowledge achieved by their students; the methodology to assess general outcomes and particularly those linked with the soft skills has to be set up and assimilated by the professors.

The European Council recently stated [10]: "the validation of learning outcomes, namely knowledge, skills and competences acquired through non-formal and informal learning can play an important role in enhancing employability and mobility...". Everyone who has been in charge of higher education has observed that during their studies, the students gain maturity, experiences in organization management, openness to social and international diversity, etc... Thus, non-formal education and informal learning are both powerful ways for an individual to gain valuable experience and skills; this fact is taken in account by the employers; during the recruitment interviews, they often spend much time discussing with the candidate about his/her activities out of the lecture rooms; for them it is a way to assess the candidate's transferable skills.

The inclusion of the non-formal education outcomes in the students' assessment is really a major issue for the next years. It has to be treated taking into account the question of the life-long learning and of "the need for more flexible learning pathways that can improve entry into and progression in the labour market, facilitate transitions between the phases of work and learning and promote the validation of non-formal and informal learning"10.

There is a general trend towards a wide diversification of the pathways to the engineer's graduation and certification; the individuals may acquire skill and competences by classical study periods, validation of professional experience, dual curricula, and online courses including the recent massive open online courses (MOOC).

As an example, in France, the law prescribes that all degrees may be delivered besides the classical academic method, either by total/partial validation of professional experiences, or by apprenticeship. More than 12 % of the 31,000 engineering master degrees awarded each year have been prepared by these alternate approaches.

The growth of apprenticeship has been very spectacular during the last years, due to governmental financial incentives and to the need to open the access of higher education. Apprenticeship combines classroom-based education and practical work experience; but at variance with many coop programmes, the work experience does not prolong the studies but is included into them (to some extent at the expense of the summer holidays). About 30% of the ECTS credits have to be assessed in the workplace by a joint team of supervisors (a professor and a professional tutor).

At which extent the same diploma can be delivered to « classical » students and to « apprentices » has been the topic of lively debates. The competence-based approach has been a powerful tool for CTI to unifying the objectives of the two pathways. In 2013, more than 100 engineering degrees are offered to students by both ways.

As a conclusion, institutions and accreditation agencies in charge of engineering education have to consider the challenge to really implement the European recommendations, based on the recent conclusions of the Conferences of European Ministers responsible for Higher Education; namely:

The member states should with a view to offering individuals the opportunity demonstrate what they have learned outside formal education and training, including mobility experiences, and to make use of that learning for their careers and further learning (...): have in place, no later than 2018,(...) arrangements for the validation of non-formal and informal learning which enable individuals to:

- have knowledge, skills and competences which have been acquired through non-formal and informal learning validated, including, where applicable, through open educational resources;
- obtain a full qualification, or, where applicable, part qualification, on the basis of validated non-formal and informal learning experiences, (...)

REFERENCES

1. Paletschek S. The invention of Humboldt and the impact of national socialism: the German University Idea in the first half of the twentieth century // Science in the Third Reich. – Oxford: Berg, 2001. – S. 37–58.
2. Albritton Frankie P. Humboldt's unity of research and teaching: influence on the philosophy and development of U. S. higher education [Electronic resource] // Social Science Research Network (SSRN): website. – Rochester, NY: Social science electronic publ., Inc., 2013. – URL: http://ssrn.com/abstract=939811, free. – Tit.from the screen (usage date: 27.07.2013).
3. Rethinking education: investing in skills for better socio-economic outcomes [Electronic resource]: communication from the Commission to the Europ. Parliament..., Strasbourg, 20.11.2012 // European commission: site. – [S. l.], 2013. – URL: http://ec.europa.eu/education/news/rethinking_en.htm, free. – Tit. from the screen (usage date: 27.07.2013).
4. A Tuning-AHELO Conceptual Framework of expected/desired learning outcomes in engineering [Electronic resource] / OECD. – [S. l.]: OECD Publ., 2011. – 55 p. – (OECD EDU Working paper; № 60). – URL: http://dx.doi.org/10.1787/5kghtchn8mbn-en, free. – Tit. from the tit. screen (usage date: 24.07.2013).
5. Terminology of quality assurance: towards shared European values? [Electronic resource] / Fiona Crozier [et al.]. – Helinki: ENQA, 2006. – 40 p. – (Occasional papers; № 12). – URL: http://www.enqa.eu/files/terminology_v01.pdf, free. – Tit. from the tit. screen (usage date: 26.07.2013).
6. EUR-ACE® system [Electronic resource] // ENAEE : Europ. network for accreditation of eng. education: offic. site. – [S. l.]: cop. ENAEE, 2012. – URL: http://www.enaee.eu/eur-ace-system, free. – Tit. from the screen (usage date: 08.08.2013).
7. ABET [Electronic resource] // ABET: the offic. site. – Baltimore, 2011. – URL: http://www.abet.org, free. – Tit. from the screen (usage date: 20.03.2013).
8. Engineering change: a study of the impact of EC2000 [Electronic resource] // ABET: [site]. – Baltimore: ABET, cop. 2011. – URL: http://www.abet.org/engineering-change/, free. – Tit. from the tit. screen (usage date: 26.07.2013).
9. Engineers survey 2012 (in French, Enquête Ingénieurs 2012), Ingénieurs et Scientifiques de France, http://www.cnisf.org 2012. Des ingénieurs et des scientifiques de France [Electronic resource]: 23 Enquête / IESF. – Paris, 2012. – 102 p. – URL: http://www.iesf.fr/enquete//2012/resultats.pdf, free. – Tit. from the tit. screen (usage date: 26.07.2013).
10. Council recommendation of 20 December 2012 on the validation of non-formal and informal learning [Electronic resource] // Offic. J. of the EU. C 398. – 2012. – Vol. 55 (22 Dec.). – P. 1–5. – URL: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2012:398:0001:0005:EN:PDF, free. – Tit. from the tit. screen (usage date: 24.07.2013).
11. Bourdoncle R. Qu'est-ce qu'une formation professionnelle universitaire? / Raymond Bourdoncle, Claude Lessard // Rev. fr. de pédagogie. – 2003. – Vol. 142. – P. 131–181.

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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.*

G. Augusti

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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REFERENCES

1. Augusti G. Accreditation of engineering programmes: a pan-European approach // Engineering education at the cross-roads of civilizations: proc. of SEFI annu. conf., Ankara, Turkey, 7-10 Sept. 2005. – Ankara : Middle East Techn. Univ., 2005. – P. 1–19.
2. Augusti G. Trans-national recognition and accreditation of engineering educational programmes in Europe: recent developments // Europ. J. Eng. Educ. – 2005. – Vol. 30, № 4. – P. 417–422.
3. Augusti G. Trans-national recognition and accreditation of engineering educational programmes in Europe: perspectives in a global framework // Ibid. – 2006. – Vol. 31, № 3. – P. 249–260.
4. Augusti G. Accreditation of engineering programmes: European perspectives and challenges in a global context // Ibid. – 2007. – Vol. 32, № 3. – P. 273–283.
5. Augusti G. EUR-ACE: an accreditation system of engineering education to be spread throughout Europe // Global cooperation in engineering education: innovative technologies, studies and professional development: proc. 2nd GCEE Int. conf., Kaunas, Lithuania, Oct. 2–4, 2008. – Kaunas: Technologija, 2008. – P. 14–19.
6. Augusti G. EUR-ACE: the European accreditation system of engineering education and its global context // Quality assurance in engineering education: a global perspective / Eds: A. S. Patil, P. J. Gray. – N. Y.: Springer, 2009. – P. 41–49.
7. Accreditation and QA of engineering education in Europe: setting up a pan-European system / G. Augusti, I. Freeston, G. Heitmann, R.-P. Martin // Implementing and using quality assurance: strategy and practice: a selection of papers from the 2nd Europ. Quality Assurance Forum, Rome, Italy, Nov. 15–17, 2007. – Brussels: Europ. Univ. Assoc. (EUA), 2008. – P. 42-47.
8. Augusti G. Quality and accreditation in engineering education in Europe: [Electronic resource]// Int. symp. on innovation and quality in engineering education, 26 – 28 Apr. 2012, Valladolid (Spain). – [Valladolid, 2012]. – 7 p. – URL: http://www.enaee.eu/wp-content/uploads/2012/02/AUGUSTI-Lecture_Valladolid.pdf, free. – Tit. from the tit. screen (usage date: 26.07.2013).
9. Augusti G. Subject-specific quality assurance and accreditation of engineering education in Europe // Proc. Int. conf. on engineering & business education, innovation and entrepreneurship, Sibiu, Romania, Oct. 18–21, 2012. – Sibiu: Lucian Blaga Univ. of Sibiu, 2012. – P. 387–392.
10. Towards the European Higher Education Area: [Electronic resource]: Communiqué of Ministers of Education, Prague, 19 May 2001 // EHEA: the offic. website. – [S. l.], cop. EHAE, 2010. – 4 p. – URL: http://www.ehea.info/Uploads/Declarations/PRAGUE_COMMUNIQUE.pdf, free. – Tit. from the tit. screen (usage date: 24.07.2013).
11. Realising the European Higher Education Area: [Electronic resource]: Communiqué of the Conference of Ministers responsible for Higher Education, Berlin, 19 Sept. 2003 // EHEA: the offic. website. – [S. l.], cop. EHAE, 2010. – 9 p. – URL: http://www.ehea.info/Uploads/Declarations/Berlin_Communique1.pdf, free. – Tit. from the tit. screen (usage date: 24.07.2013).
12. EUR-ACE Framework Standards for the accreditation of engineering programmes: [Electronic resource]: approv. by the ENAEE Administrative Council on 5 Nov. 2008 // ENAEE: the offic. website. – [S. l.], cop. ENAEE, 2012. – 14 p. – URL: http://www.enaee.eu/wp-content/uploads/2012/01/EUR-ACE_Framework-Standards_2008-11-0511.pdf, free. – Tit. from the tit. screen (usage date: 24.07.2013).
13. Commentary on EUR-ACE Framework Standards for the accreditation of engineering programmes: [Electronic resource]: approv. by the ENAEE Administrative Council on 5 Nov. 2008 // ENAEE: the offic. website. – [S. l.], cop. ENAEE, 2012. – 8 p. – URL: http://www.enaee.eu/wp-content/uploads/2012/01/Commentary-on-EUR-ACE_Framework-Standards2.pdf, free. – Tit. from the tit. screen (usage date: 24.07.2013).
14. A Framework for qualifications of the European Higher Education Area: [Electronic resource] / Bologna Working Group on qualifications frameworks; Ministry of Science, Technology and Innovation. – Copenhagen: Grefta Tryk A/S, 2005. – 200 p. – URL: www.bologna-bergen2005.no/Docs/00-Main_doc/050218_QF_EHEA.pdf, free. – Tit. from the tit. screen (usage date: 24.07.2013).
15. Joint Quality Initiative: Shared 'Dublin' Descriptors for Short Cycle, First Cycle, Second Cycle and Third Cycle Awards (2004); www.jointquality.org

16. Standards and guidelines for quality assurance in higher education (ESG) [Electronic resource] / ENQA. – Helsinki: ENQA, 2005. – 41 p. – URL: http://www.enqa.eu/files/ENQA%20Bergen%20Report.pdf, free. – Tit. from the tit. screen (usage date: 24.07.2013).
17. Directive 2005/36/EC of the European Parliament and of the Council of 7 September 2005 on the recognition of professional qualifications [Electronic resource] // Offic. J. of the EU. L 255. – 2005. – Vol. 48 (30 Sept.). – P. 22–142. – URL: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:255:0022:0142:EN:PDF, free. – Tit. from the tit. screen (usage date: 24.07.2013).
18. Feyo de Azevedo S. High level qualification frameworks and the EUR-ACE framework standards - do they fit together? [Electronic resource] // 4th ENAEE General Assembly and Workshop «Overarching and sectoral frameworks at the European and the global scale», Brussels, 22 Jan. 2009. – Brussels, 2009. – 17 p. – URL: http://www.enaee.eu/wp-content/uploads/2012/01/Brussels-09-Feyo_GA220109_Paper1.pdf, free. – Tit. from the tit. screen (usage date: 24.07.2013).
19. ENAEE standards and guidelines for accreditation agencies [Electronic resource] / ENAEE. – [S. l.], 2007. – 8 p. – URL: http://www.enaee.eu/wp-content/uploads/2012/01/ENAEE-Standards-and-Guidelines-for-Accreditation-Agencies-2007-04-191.pdf, free. – Tit. from the tit. screen (usage date: 24.07.2013).
20. A Tuning-AHELO Conceptual Framework of expected/desired learning outcomes in engineering [Electronic resource] / OECD. – [S. l.]: OECD Publishing, 2011. – 55 p. – (OECD EDU Working Paper; № 60). – URL: http://dx.doi.org/10.1787/5kghtchn8mbn-en, free. – Tit. from the tit. screen (usage date: 24.07.2013).
21. ECDEAST: Engineering curriculum design aligned with the EQF and EUR-ACE Standards [Electronic resource]: [website]. – Tomsk: TPU, 2010–2013. – URL: www.ecdeast.tpu.ru/en, free. – Tit. from the screen (usage date: 24.07.2013).

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

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Program Outcomes: The Core of Program Accreditation*

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Key words: *engineering education, accreditation, outcome-based evaluation, program outcomes.*

Program outcomes, which are statements defining the knowledge, skills, and attitudes that students must acquire by the time they graduate, is at the core of accreditation processes. MÜDEK is a non-governmental organization that carries out outcome-based evaluation and accreditation of engineering programs of Turkey. A comparative account, in the light of eleven years of experience, of the first cycle program outcomes of MÜDEK is given.

Introduction

Accreditation of engineering programs is increasingly being recognized as a key instrument that enhances and improves the quality of engineering education and that contributes to mobility of engineers around the world. International organizations such as ENAEE (European Network for Accreditation of Engineering Education) [1] and IEA (International Engineering Alliance) [2] are moving towards setting global standards in accreditation criteria for engineering programs.

The trend that engineering program accreditation should be outcome-based [3] has been initiated by ABET [4] around 2000 and has now been accepted by almost all national accreditation agencies and by both ENAEE and IEA. This has elevated the program outcomes which are statements defining the knowledge, skills, and attitudes that students must have acquired by the time they graduate, to be the core of program accreditation practice in engineering. Such statements are built in the EUR-ACE Framework Standards [1, 5] that are used in accreditation practices of ENAEE and are formulated as Washington Accord Graduate Attributes [2] with the objective of

* *An earlier version of this article was presented in "2nd International Engineering Education Conference", Antalya, Turkey, 31 October - 03 November 2012.*

serving as a common denominator for the engineering program accreditation activities of member countries of IEA. It is essential to recognize that the program outcomes used by a country's accreditation agency must on one hand observe the national (educational and professional) qualifications framework [6], if any, and must also be compatible with international standards of engineering educational outcomes, on the other. The former ensures that engineering graduates do not face obstacles in achieving professional qualifications inside the country and the latter ensures that they may attain worldwide mobility in carrying out their profession.

MÜDEK [7] is a non-governmental organization that started outcome-based evaluation and accreditation of four-year engineering programs, leading towards a Bachelor's degree, in Turkey in 2003. It became a member of ENAEE in 2006, was authorized by ENAEE to award EUR-ACE Label in 2009, and became a signatory of Washington Accord of the IEA in 2011. The rules and procedures used by MÜDEK in evaluating a program are detailed in MÜDEK's Directive on Policies and Procedures for Evaluation and Accreditation document [8]. The process starts with the institution submitting a self-evaluation report for programs that seek accreditation and involves a 3-day onsite visit to the institution carrying out these programs by a team of evaluators.

Program outcomes used by MÜDEK in 2003 were similar to outcomes "(a)-to-(k)" of ABET but have been revised in 2008 in order to:

I) incorporate accumulated experience gained by five years of program accreditation;

II) make them compatible with EUR-ACE Framework Standards and Washington Accord Graduate Attributes;

III) encompass National Higher-Education Qualifications Framework for engineering education.

This article gives a comparative account of the program outcomes criteria of MÜDEK focusing on their strengths and weaknesses apprehended in the light of eleven years of program accreditation practice in engineering. First we expound on the central role played by the criterion of program outcomes in the outcome-based accreditation processes. Then, based on [9], we summarize the main areas where engineering programs have difficulties in complying with the MÜDEK Program Outcomes criteria based on the findings by MÜDEK in its accreditation practice. The next section contains a summary and a brief comparison among the MÜDEK Program Outcomes, the relevant EUR-ACE Framework Standards, and Washington Accord Graduate Attributes. The last section presents results and conclusions.

Why Program Outcomes are so Central

The criterion of program outcomes that specifies the knowledge, skills, and attitudes that students must have acquired by the time they graduate is one of many other criteria that an engineering program is expected to comply with. This is a common situation in most outcome-based evaluation procedures that are adopted by accreditation agencies like ABET [4], Japan Accreditation Board for Engineering Education [10], German Accreditation Agency for Study Programs in Engineering, Informatics, Natural Sciences and Mathematics [11], Association for Engineering Education of Russia [12], and MÜDEK. For example, MÜDEK Accreditation Criteria used for evaluating four-year (first-cycle) engineering programs leading towards a Bachelor's degree have the ten components [7]:

Criterion 1. Students.

Criterion 2. Program Educational Objectives.

Criterion 3. Program Outcomes.

Criterion 4. Continuous Improvement.

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Criterion 5. Curriculum.

Criterion 6. Faculty Members.

Criterion 7. Facilities.

Criterion 8. Institutional Support and Financial Resources.

Criterion 9. Organization and Decision-Making Processes.

Criterion 10. Discipline-Specific Criteria.

Among these criteria, 1 and 5-9 are input-based while criteria 2, 3, and (in some part) 10 are output-based. A combination of input and output based criteria is a common feature observed in the requirements of most accreditation agencies, such as listed above. Continuing with the MÜDEK example, Criterion 4 makes explicit that "Programs should provide evidence that they use the results obtained through their assessment and evaluation system for their continuous improvement. These improvement efforts must rest on solid data gathered systematically in all areas in need of development, primarily as related to Criteria 2 and 3." [7]. Programs usually need to gather such data from its alumni and their employers in case of Criterion 2 since program educational objectives are general statements defining the career goals and professional accomplishments that graduates are expected to achieve in 2-4 years after graduation. In case of Criteria 3 and 10, such data need to be obtained from student work and fresh graduates of the program. It is a common complaint of program administrators that it is difficult to reach the alumni and obtain feedback. Moreover, the employers or supervisors of past graduates of a program are quite uncooperative in providing feedback that can be so useful to a program administrator in measuring the degree of compliance with Criterion 2. It follows that, from the point of view of a program administrator, Criterion 3 is more amenable to collecting reliable data that may demonstrate compliance, because the source of data is much more reachable when it comes to assessing outcomes. This is also true from the perspective of the accreditation agency and its evaluators, not only because the data is more reliable but also because most source of data is in their reach as well. In case a sloppy administrator neglects collecting sufficient evidence for Criterion 3, the evaluator can easily ask the institution that a specific data is collected during the evaluation period. Thus, the relative ease of demonstrating compliance or noncompliance is the first reason why Program Outcomes is so central to program evaluation.

Statements that define educational and professional qualifications in engineering discipline are also, like those in Criterion 3, statements that specify the knowledge, skills, and attitudes of an individual. True, intended to be applicable in a different environment than academic, but nevertheless similar statements! National qualifications frameworks (NQF) have turned into key instruments for the restructuring and reforming of education, training, and qualifications systems in Europe during the last five years. In [6], NQF is described as "an instrument for the classification of qualifications according to a set of criteria for specified levels of learning achieved, which aims to integrate and coordinate national qualifications subsystems and improve the transparency, access, progression and quality of qualifications in relation to the labor market and civil society". Statements that define qualifications need to be as precise, easy-to-understand, unambiguous as possible, and therefore easy to implement, assess, and measure. The same is true in case of program outcomes. It is indeed our experience that engineering programs in Turkey are able to define and evaluate their program outcomes much easier than, say, their program educational objectives [9]. Ease of formulation and close ties with professional qualifications is the second reason why program outcomes are central in an accreditation process.

MÜDEK Experience of Compliance with Program Outcomes

According to MÜDEK, every engineering program to be evaluated must define their (intended) program outcomes so as to cover all knowledge, skills, and attitude components necessary to accomplish their program educational objectives, and to include the mandatory MÜDEK Outcomes given in Table 1. Programs must have an on-going assessment and evaluation process in place in order to periodically determine and document in how far these program outcomes are being achieved. Furthermore, programs are required to demonstrate (by providing evidence) that their students have achieved the program outcomes by the time they graduate.

Criterion 3 (Program Outcomes) related shortcomings most frequently observed during general evaluations of a total of 70 first cycle programs conducted during 2010-2011 and 2011-2012 evaluation periods are summarized in Table 2.

The first shortcoming listed in Table 2 is mainly observed in programs that are subjected to a cyclic general re-evaluation for the extension of their accreditation. The reason behind this is that such programs have failed to update their intended learning outcomes in parallel with the revisions made in MÜDEK evaluation criteria (in particular the program outcomes criteria) which took place at the end 2008 with a one year transition period given to institutions.

Second and third items in Table 2 are mostly observed in programs which are subject to a general evaluation for the first time. The main reason behind these two shortcomings is the lack of experience of programs in methods to be used for assessing achievement of program outcomes, particularly on methods directly based on student coursework. Furthermore, a lack of planned and coordinated effort in assessment of program outcomes and analysis of such assessment results also reflects as further shortcoming under Criterion 4 (Continuous improvement) in most programs.

Although not quantified here, these findings can be extended to all ten years of MÜDEK evaluated programs. It should also be noted that most programs also have difficulty of compliance with some new criteria incorporated in 2008, like 3.7, 3.10, and 3.11, but a shortcoming decision has been made for only a few programs. This is apparently because MÜDEK evaluators are more tolerant when they evaluate programs' compliance with newly incorporated criteria. On a positive note, most of the evaluated programs have no difficulty of compliance with the outcomes 3.1, 3.2, 3.4, and 3.5. A look at these criteria in Table 1 will show that it is relatively easier to collect evidence of compliance for these criteria from student works.

EUR-ACE Framework Standards, WA Graduate Attributes, and MÜDEK Program Outcomes

EUR-ACE Accreditation System is a decentralized accreditation system of educational programs as entry route to the engineering profession in Europe. The EUR-ACE Framework Standards, maintained by the ENAEE, provide the basis for awarding a common quality label, called EUR-ACE Label, to engineering programs after reviewing their accreditation procedure and does not substitute for national standards. EUR-ACE Accreditation System is currently implemented by nine agencies in Europe. ENAEE authorizes these agencies to add the EUR-ACE label to their accreditation. These are ASIIN (Germany), CTI (France), Engineering Council (UK), Engineers Ireland, Ordem dos Engenheiros (Portugal), AEER (Russia), MÜDEK (Turkey), ARACIS (Romania), and QUACING (Italy).

The EUR-ACE Framework Standards distinguish between First Cycle and Second Cycle degrees and specify 21 program outcomes for first cycle degrees and 23 for second cycle degrees,

Table 1. Program Outcomes stated in MÜDEK Criterion 3

Engineering programs must demonstrate that their graduates have acquired the following 11 outcomes:

1. Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.
2. Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modelling methods for this purpose.
3. Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way so as to meet the desired result; ability to apply modern design methods for this purpose. (Realistic constraints and conditions may include factors such as economic and environmental issues, sustainability, manufacturability, ethics, health, safety issues, and social and political issues according to the nature of the design.)
4. Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.
5. Ability to design and conduct experiments, gather data, analyse and interpret results for investigating engineering problems.
6. Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.
7. Ability to communicate effectively in Turkish, both orally and in writing; knowledge of a minimum of one foreign language.
8. Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.
9. Awareness of professional and ethical responsibility.
10. Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.
11. Knowledge about contemporary issues and the global and societal effects of engineering practices on health, environment, and safety; awareness of the legal consequences of engineering solutions.

Table 2. Most frequently observed shortcomings concerning MÜDEK Criterion 3 Program Outcomes

Nature of Shortcoming	%
Intended program outcomes do not fully cover the mandatory MÜDEK outcomes	18
Insufficient assessment process is used for determining the extent of achievement of program outcomes by the students. (Usually only surveys or passing grades in courses are being used)	41
Insufficient evidence is provided to show that their students have achieved the program outcomes by the time they graduate	26
Lack of evidence demonstrating that the students have acquired the ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way so as to meet the desired result; ability to apply modern design methods for this purpose	18
Lack of evidence demonstrating that the students have acquired the ability to work efficiently in intra-disciplinary and multi-disciplinary teams	10

grouped under the profiles: Knowledge and Understanding, Engineering Analysis, Engineering Design, Investigations, Engineering Practice, Transferable (personal) Skills. Although all six of the program outcomes apply to both first cycle and second cycle programs, there are important differences in the requirements at the two levels. These differences are particularly relevant to those learning activities that contribute directly to the program outcomes concerned with engineering applications. A full listing of the EUR-ACE Program Outcomes can be found at [1].

IEA consists of six international agreements governing mutual recognition of engineering educational qualifications and professional competence. Countries who wish to participate in any of these agreements, apply for membership, and if accepted become signatories to the agreement. The Washington Accord (WA), signed in 1989, is one of these agreements among agencies responsible for accrediting engineering degree programs. It recognizes the substantial equivalency of programs accredited by those agencies and recommends that graduates of programs accredited by any of the signatory agencies be recognized by the other agencies as having met the academic requirements for entry to the practice of engineering. Currently there are 15 signatories of WA represented in each country by the agency responsible for accreditation of bachelors or fist cycle engineering programs. These are Australia, Canada, Chinese Taipei, Hong Kong China, Ireland, Japan, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, United Kingdom, and United States.

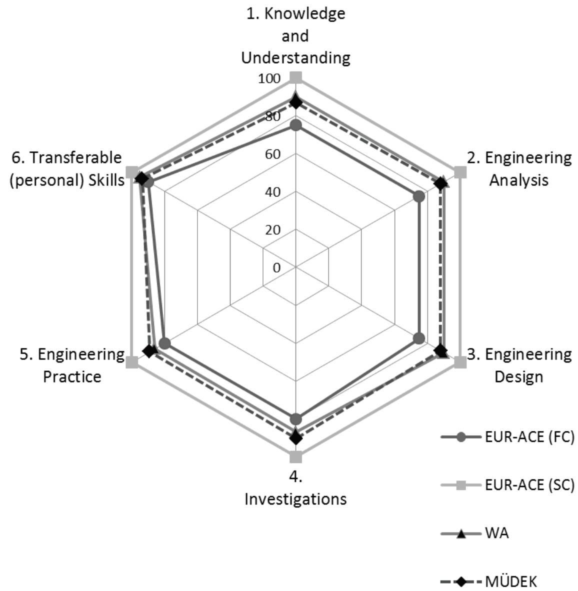
WA Graduate Attributes [2] provide a widely accepted common reference for accreditation agencies to describe the outcomes of substantially equivalent qualifications. There are twelve WA Graduate Attribute Profiles, which are Engineering Knowledge, Problem Analysis, Design/development of solutions, Investigation, Modern Tool Usage, The Engineer and Society, Environment and Sustainability, Ethics, Individual and Team work, Communication, Project Management and Finance, Lifelong learning.

Juxtaposing the four program outcomes of EUR-ACE First Cycle, EUR-ACE Second Cycle, MÜDEK, and WA Graduate Attributes, and use the six profiles of EUR-ACE as the basis, we can depict the chart in Figure 1 that makes a conceptual comparison. Thus, EUR-ACE Second Cycle program outcomes stand as the most demanding, followed by WA Graduate Attributes and MÜDEK Program Outcomes. EUR-ACE First Cycle program outcomes are the least demanding among the four. In "Knowledge and Understanding" profile, for example, there are slight differences between MÜDEK Program Outcomes and WA Graduate Attributes while both are substantially more demanding than EUR-ACE First Cycle program outcomes and less demanding than EUR-ACE Second Cycle program outcomes. In "Investigations" profile, MÜDEK Program Outcomes are slightly more demanding than WA Graduate Attributes. Currently, working groups from IEA and ENAEE are, in parallel, looking at the comparison between Graduate Attributes and EUR-ACE Framework Standards with the aim of reaching a consensus on substantial equivalencies among them. On a separate track, IEA has taken a decision that all WA signatories bring their program outcomes to a substantially equivalent level to WA Graduate Attributes by the year 2019.

Results and Discussion

Initiated by ABET around 2000, outcome-based evaluation has now been accepted by almost all national engineering educational accreditation agencies and by both ENAEE and IEA. The relative ease of demonstrating compliance or noncompliance, ease of formulation, and close ties with profes-

Fig. 1. A conceptual comparison



sional qualifications are reasons that make program outcomes the core of an outcome-based evaluation process.

Evaluation of a total of 70 first cycle programs by MÜDEK in the last two years is representative of shortcomings of the engineering programs in complying with program outcomes criteria. Almost half of evaluated programs have used an insufficient assessment process for determining the extent of achievement of program outcomes by the students. In almost one third of them intended program outcomes do not fully cover the mandatory MÜDEK Outcomes and have failed to provide sufficient evidence for MÜDEK Outcome 3.3 on complex system/process/device design. Some programs also had difficulty in complying with MÜDEK Outcome 3.6 on the ability to work efficiently in intra-disciplinary and multi-disciplinary teams.

When compared with regard to the level of strictness of standards, MÜDEK Program Outcomes are less demanding than EUR-ACE SC outcomes but more than EUR-ACE FC outcomes. At certain outcome profiles, it is also less demanding than WA Graduate Attributes, however, a revision for substantial equivalence is under way.

Outcome-based evaluation is only one method among a number of different program evaluation types, such as process- or goals-type methods [13], and it is not the perfect method. Program outcomes, if not clearly formulated and if are not amenable to collecting data, may not be assessable. It follows that they themselves need to be periodically assessed and revised. MÜDEK outcomes have been revised twice but it is already time for a third version, this time giving more thought to whether each MÜDEK Outcome is formulated so that each program administrator and every MÜDEK evaluator clearly understands the requirements for its implementation and can easily imagine how data can be collected as evidence of compliance for that outcome. More studies like [9] will provide many hints for implementing these features.

REFERENCES

1. ENAEE, EUR-ACE Framework Standards for the Accreditation of Engineering Programmes, 05.11.2008, www.enaee.eu, [Last visited May 25, 2013].
2. IEA, International Engineering Alliance Graduate Attributes and Professional Competencies, ver.2, 18 June 2009, www.washingtonaccord.org, [Last visited May 15, 2013].
3. Schalock, R. L., Outcome-Based Evaluation, Plenum Publishers, New York, 1995.
4. ABET, Criteria for Accrediting Engineering Programs, http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Process/Accreditation_Documents/Current/eac-criteria-2012-2013.pdf, [Last visited May 25, 2013].
5. Augusti, G., Birch, J., Payzın, A. E., «EUR-ACE: A System of Accreditation of Engineering Programmes Allowing National Variants,» INQAAHE 2011 Conference, Madrid, 4-7 April 2011.
6. CEDEFOP, The Development of National Qualifications Frameworks in Europe, http://www.cedefop.europa.eu/en/files/6104_en.pdf, [Last visited May 25, 2013].
7. MÜDEK, Criteria for Evaluating First Cycle (Bachelor) Engineering Programs, http://www.mudek.org.tr/doc/en/MUDEK-Evaluation_Criteria_(2.0.1).pdf [Last visited June 15, 2013].
8. MÜDEK, Directive on Policies and Procedures for Evaluation and Accreditation, http://www.mudek.org.tr/doc/en/MUDEK-Directive_on_PPEA_(1.5.1-11.10.2012).pdf [Last visited May 31, 2013].
9. Payzın, A.E., Platin, B.E., «A Decade of Experience on Outcome Based Accreditation: Still a Long Way To Go,» The First ENAEE Conference, Porto, Portugal, 15-16 November, 2012.
10. JABEE, Common Criteria for Accreditation of Professional Education Programs, Applicable in the years 2012, http://www.jabee.org/english/OpenHomePage/JABEE_Common_Criteria_2012.pdf, [Last visited May 25, 2013].
11. ASIIN, General Criteria for the Accreditation of Degree Programmes, http://www.asiin-ev.de/pages/en/asiin-e.-v/programme-accreditation/general-criteria-and-ssc.php, [Last visited May 25, 2013].
12. AEER, Criteria and Procedures for Accrediting Engineering Programs in Engineering and Technology, http://www.ac- raee.ru/eng/kriterii.php, [Last visited May 25, 2013].
13. McNamara, C., Basic Guide to Program Evaluation (Inc. Outcomes Evaluation), Free Management Library, http://managementhelp.org/evaluation/program-evaluation-guide.htm, [Last visited May 25, 2013].

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QUACING Approach to EUR-ACE Accreditation

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Key words: *engineering programme quality certification, engineering programme quality assessment, engineering programme accreditation.*

The paper presents the QUACING approach to the EUR-ACE accreditation of Engineering programmes with reference to both accreditation conditions: the consistency of the programme outcomes established by the programmes with the EUR-ACE programme outcomes and a positive assessment of the programme quality.

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Introduction

QUACING, the Italian Agency for the EUR-ACE accreditation of Engineering programmes[1], was established at the end of 2010 on the initiative of the Conference of the Deans of Italian Engineering Faculties (CoPI), the Foundation of the Conference of the Rectors of the Italian Universities (CRUI Foundation), the National Engineers' Council (CNI), the official representative body of the Italian engineers, member of FEANI, Finmeccanica, Italy's leading manufacturer in the high technology sector and ranks among the top ten global players in aerospace, defense and security, the FIAT Research Centre (C.R.F.) and the National Association of Building Contractors (ANCE).

The goals of the Agency are established in the Statute. They are:

- the quality certification and EUR-ACE accreditation of Engineering programmes;
- the promotion of the quality of Engineering programmes and the development of quality culture among the staff working for Engineering programmes;
- the promotion of correct information on the quality of Engineering programmes at both national and international levels;
- the promotion of the recognition of Engineering titles in Europe.

The Agency is new, but it has inherited all the experience acquired by CRUI before and by CRUI Foundation after in more than 15 years of activity in the field of quality assessment of University programmes. It is a fact that CRUI and CRUI Foundation have been and are the organisations most committed to promoting the quality of the educational services offered by Universities in our country, even if, in particular in the first years of activity, the quality assessment was mainly centred in the assessment of the management system than of the results of programmes.

From the activity of programme quality assessment we have learnt that the most difficult thing in an assess-

[1] *QUACING refers always to "EUR-ACE accreditation" to avoid conflicts of competence with ANVUR, the recently established official Italian Agency which by law will have competence on programme accreditation.*

ment process is to obtain the same assessment from different assessors. Consequently, in order to make the assessments as objective as possible, we have established some assessment criteria and necessary requirements, with reference to both conditions for the EUR-ACE accreditation, i.e.:

- the consistency of the established programme outcomes with a set of reference programme outcomes that are defined in the QUACING By-laws and in turn are consistent with the EUR-ACE programme outcomes;
- a positive assessment of the programme quality, where for "quality" we intend the level of fulfilment of the educational objectives established coherently with the needs and expectations of all who have an interest in the educational service offered by the programme (interested parties), or, in other words, the level of fulfilment of the established "quality requirements".

Furthermore, it seems important to underline that in our understanding the accreditation process is not only a matter of "consumer protection", requiring a clear distance to be established between the accrediting agency and the programmes to be assessed, but at the same time it must constitute a provision of advice and guidance in pursuit of improvements in their quality, which requires a close relationship between the assessor and the assessed. In other words, we intend the aim of accreditation as a balance between accountability and improvement.

The aim of this paper is to present the criteria (as a consequence of some characteristics of our programmes), the above mentioned programme outcomes of reference and the requirements (intended as necessary conditions) established for the EUR-ACE accreditation, and the Model adopted for the internal assurance and the assessment of programme quality.

Assessment of the Consistency of Programme Outcomes

The first question which has required the definition of accreditation criteria is related to the organisation of our first cycle programmes after Bologna.

According to the ministerial decree which regulates the organisation of University studies in Italy [1], the first cycle Laurea programmes should have the aim "to supply student with adequate mastering of scientific methods and contents, even when oriented to the acquisition of specific professional competences".

Furthermore, in spite of the original objective to fulfil the majority of the job market needs with first cycle graduates, most first cycle graduates (between 70 and 80%) have chosen and are choosing to prosecute their studies in the second cycle programmes[2].

As a consequence almost all the first cycle programmes in Engineering offer an educational path oriented to the prosecution of studies in the second cycle Laurea Magistrale programmes. They may be subdivided in the following three categories:

- first cycle programmes with the aim to supply student with adequate mastering of scientific methods and contents, oriented to the prosecution of studies;
- first cycle programme with the aim to supply student with both adequate mastering of scientific

[2] *Two reasons at least for this choice.*
One is certainly the opinion of students, families and, in general, of the public that the first cycle degree is of less value than the second cycle one.
The other is represented by the fact that, if it is true that the education of three-year practice-oriented graduates was strongly supported by representatives of the labour market, it is also true that big industry never showed interest in these new professional figures, while small industry, which constitutes the actual industrial Italian fabric, has proved to be too small to take on even first cycle graduates.

methods and contents and specific professional competences;

- first cycle programmes which offer two educational paths, generally in the final year or in the final six-month period: one oriented to the prosecution of studies in second cycle programmes and one job oriented (the so-called "Y model", a solution adopted by many Engineering fist-cycle programmes).

As well known, a necessary condition for the EUR-ACE accreditation is that the degree programmes provide the education necessary for entry to the engineering profession. So we have established that, as a rule, accreditation can be granted only to first cycle programmes which offer an educational path job oriented or with the aim to supply specific professional competences. In both cases the presence of an adequate training period (at least 15 ECTS, according to our experience) is considered an important assessment element.

A second question which has required the definition of guidelines for our assessors is related to the assessment of the consistency of the programme outcomes established by the programmes with the EUR-ACE programme outcomes.

It is a fact that in Italy programmes have to define their programme outcomes, which should be a specification of the 'qualifying educational objectives' established by law in terms of programme outcomes for each of the 'classes' which programmes belong to [2, 3]. But, even if our country was the first to fully adopt the organisation in cycles of the University programmes required by the Bologna process, it is again a fact that our programmes have not yet metabolized the need to design the educational path starting from the definition of the programme outcomes and then to define a syllabus consistent with the established programme outcomes. On the contrary, the design of the educational path generally starts with the definition of the syllabus.

The result is that in general the "official" programme outcomes are very general, like the qualifying educational objectives established by law, and the "real" programme outcomes, which are the result of the learning outcomes specific of the didactic units of the syllabus, are not clearly defined.

As a consequence, the consistency of the programme outcomes with the EUR-ACE ones must be assessed with reference to the learning outcomes of the didactic units of the syllabus and to the presence of the educational activities necessary for their achievement.

A definition of the programme outcomes consistent with the EUR-ACE programme outcomes is certainly an improvement that we would like to promote with the accreditation process.

Another improvement that the accreditation process should promote is the attention to be paid by programmes to the definition of the transferable skills expected at the end of the educational process, to the definition of the associated didactic activities and particularly to the assessment of their achievement by students. At the moment this is certainly a weak point of our educational system, which in general and in spite of the solicitations of the labour market is reluctant to recognise the transferable skills of the same importance of the specific skills.

Of course, the programme outcomes we have to consider in the accreditation process are those established in the EUR-ACE Framework Standards [4], but also those established for each of the "classes" which programmes belong to [2, 3]. This has required the integration and revision of the EUR-ACE programme outcomes, to take into account the national requirements and understanding. The "QUACING Programme Outcomes" [5], consistent with the EUR-ACE and the national ones, are reported in Annex 1.

At the same time we have matured the conviction that some of the

EUR-ACE formulations and statements for sure need an improvement, particularly in order to clarify what is required and reduce the needs of their interpretation as far as possible.

Assessment of the Programme Quality

As for the assessment of the programme quality, the first necessary condition for a positive assessment that we have established is the presence of an internal quality assurance system.

As well known, "quality assurance" is a generic term which lends itself to many interpretations. For "internal quality assurance" we intend all the activities (processes) for the programme management finalised to the achievement of the established objectives and then aimed at "ensuring trust" in meeting the quality requirements to all interested parties. Therefore the quality assurance activities have to be concentrated on the activities necessary to provide objective evidence of the achieved quality.

Coherently with this definition, our approach to internal quality assurance requires:

- the definition of programme outcomes consistent with the needs and expectations of the society in general and of the labour market in particular;
- the design and planning of an educational path and the availability of academic staff, facilities, partnerships and student services suitable for the achievement of the established programme outcomes;
- the monitoring of the results of the educational process in order to assess the level of achievement of the established objectives and therefore the quality of the educational service offered;
- the continual or at least periodic improvement of the programme, through a process of self-assessment, finalised to the identification of the strong and weak points of the educational service offered, and a revision process, finalised to the adoption of the necessary improvement actions: it is a fact that to assure the programme quality means also that every effort is made to promote its constant improvement.

To promote the adoption of internal quality assurance systems consistent with this approach, an "ad hoc" instrument, the Model for internal assurance and assessment of programme quality [6], has been defined.

Starting from the definition of a set of "quality requirements" consistent with the requirements for programme assessment and subdivided in the same areas established in the EUR-ACE Framework Standards [4]:

Area A – Needs and Objectives,
Area B – Educational Process,
Area C – Resources (comprehensive of Partnerships),
Area D – Monitoring,
Area E – Management System,

the Model identifies the processes necessary for a management for quality of the programmes.

Then, for each identified process, the Model presents the behaviours expected by the programmes to fulfil the associated quality requirements. The whole of the expected behaviours constitutes the "QUACING System" for a management for quality of the programmes.

Furthermore, the Model specifies the informative documentation considered necessary to provide documental evidence of the programme quality. And the availability of a complete documentation of the established objectives and educational activities, available learning resources, results of the educational process and management system is the second necessary condition for a positive assessment of the programme quality.

The information and data of the informative documentation constitute also a necessary reference for the internal and external programme assessments.

Finally, the Model specifies the assessment criteria, which constitutes the reference for the identification of the strong and weak points of the educational service offered and the determination of the level of fulfilment of the quality requirements. They may be:

- "coherence" criteria (e.g., coherence of the syllabus and of the characteristics of the didactic units with the established programme outcomes);
- "suitability" criteria (e.g., suitability of the academic staff for the achievement of the established programme outcomes).

When possible, the Model associate the criteria one or more indicators, useful in order to assess the level of fulfilment of the associated criterion.

The identified indicators may be "observable" or "measurable".

The observable indicators are indicators for which it is not possible to establish a unit of measurement (e.g., suitability of the admission requirements for a profitable participation of the students to the didactic activities of the first course year). Consequently, the assessment of the observable indicators relies on the preparation, capacity and experience of the assessors.

The measurable indicators are indicators for which it is possible to establish a unit of measurement (e.g., number of seats in a classrooms). They can be measured and consequently permit an objective assessment of their level of fulfilment.

Conclusions

The established accreditation criteria, guidelines and requirements, together with the programme outcomes of reference and the Model for internal assurance and assessment of programme quality, have certainly favoured homogeneous behaviours by the assessors in the first external visits for the EUR-ACE accreditation managed by QUACING Agency, whose final objective is the definition of a "Guide for assessors", with clear indications on the criteria and necessary conditions for the EUR-ACE accreditation.

At the same time the Model has proved to be a useful instrument for the implementation or the improvement of the internal quality assurance system of the programmes.

It is our opinion that the definition of similar criteria and conditions by ENAEE could be useful also in order to guarantee homogeneous behaviours by the Agencies authorised to grant the EUR-ACE label.

ANNEX1 – QUACING PROGRAMME OUTCOMES

Knowledge and Understanding

Graduates should demonstrate knowledge and understanding at different levels of mathematics, sciences and engineering disciplines underlying their engineering specialisation and of the wider context of engineering. The underpinning knowledge and understanding of the fundamentals of their engineering specialisation are essential to satisfying the other programme outcomes.

First Cycle graduates should demonstrate:

- knowledge and understanding of mathematics and sciences underlying their engineering specialisation;
- knowledge and understanding of engineering disciplines underlying their specialisation, including some knowledge at its forefront;
- awareness of the wider multidisciplinary context of engineering.

Second Cycle graduates should demonstrate:

- advanced knowledge and understanding of mathematics and sciences underlying their engineering specialisation;
- advanced knowledge and understanding of engineering disciplines underlying their specialisation, including a critical awareness of its forefront;
- a critical awareness of the wider multidisciplinary context of engineering.

Engineering Analysis

Graduates should be able to analyse and solve engineering problems consistent with their level of knowledge and understanding and to recognise the importance of societal, health and safety, environmental and industrial/commercial constraints. Analysis can include the identification of the problem, clarification of the specification, consideration of possible methods of solution, selection of the most appropriate method, and correct implementation. Graduates should be able to use a variety of methods, including analytical methods, computational modelling and experimental methods.

First Cycle graduates should demonstrate:

- the ability to identify, formulate and solve engineering problems using established and relevant analytic, modelling and experimental methods;
- the ability to analyse engineering products, processes and systems.

Second Cycle graduates should demonstrate:

- the ability to solve problems that are unfamiliar, incompletely defined, and have competing specifications;
- the ability to formulate and solve problems in new and emerging areas of their specialisation;
- the ability to conceptualise engineering products, processes and systems;
- the ability to apply innovative methods in problem solving.

Engineering Design

Graduates should be able to realise engineering designs consistent with their level of knowledge and understanding. The designs may be of products (devices, artefacts, etc.) processes or systems and the specifications could be wider than technical, including an awareness of societal, health and safety, environmental and industrial/commercial considerations.

First Cycle graduates should demonstrate:

- the ability to develop and realise designs to meet defined and specified requirements, applying relevant design methodologies.

Second Cycle graduates should demonstrate:

- the ability to design solutions to unfamiliar problems, possibly involving other discipline, and to work with complexity, technical uncertainty and incomplete information;
- the ability to use creativity to develop new and original ideas and methods.

Investigations

Graduates should be able to use appropriate methods to pursue investigations and research of technical issues consistent with their level of knowledge and understanding.

Investigations may also involve execution of experiments and interpretation of data.

First Cycle graduates should demonstrate:

- the ability to conduct searches of literature and to consult and use data bases and other sources of information;
- the ability to consult and apply codes of practice and safety regulations;
- the ability to conduct analytic and modelling investigations;
- laboratory skills and the ability to conduct experiments;
- the ability to interpret data and draw conclusions.

Second Cycle graduates should demonstrate:

- the ability to identify, locate and obtain required data;
- the ability to design and conduct analytic, modelling and experimental investigations;
- the ability to critically evaluate data and draw conclusions;
- the ability to investigate the application of new and emerging technologies in their specialisation.

Engineering Practice

Graduates should develop practical skills for solving problems, design and realise engineering products, processes and systems, conducting investigations. These skills may include the knowledge, use and limitations of: materials; equipment and tools; technologies; analytic, modelling and experimental techniques and methods. They should also recognise the wider, non-technical implications of engineering practice.

First Cycle graduates should demonstrate:

- the ability to combine theory and practice to solve engineering problems;
- the ability to select and use appropriate materials, equipment and tools, technologies;
- the knowledge and understanding of applicable techniques and methods and of their limitations and the capacity to select appropriate techniques and methods;
- awareness of the health, safety and legal issues and responsibilities of engineering practice and of the impact of engineering solutions in a societal and environmental context;
- commitment to professional ethics, responsibilities and norms of engineering practice;
- awareness of economic, organisational and managerial issues (such as project management, risk and change management) of the business context.

Second Cycle graduates should demonstrate the same practical skills of a First Cycle graduate at the more demanding level of Second Cycle and furthermore:

- the ability to integrate knowledge from different branches, and handle complexity;
- the critical awareness of the non-technical implications of engineering practice.

Transferable Skills

The skills necessary for the practice of engineering, and which are applicable more widely, should be developed within the programme.

First Cycle graduates should be able to:

- function effectively as an individual and as a member of a team;
- communicate effectively in writing and orally, using at least another language of the European Union other than Italian;
- recognise the need for, and have the ability to engage in, independent life-long learning.

Second Cycle graduates should fulfil all the transferable skill requirements of a First Cycle graduate at the more demanding level of Second Cycle and should be able to:

- function effectively as leader of a team that may be composed of different disciplines and levels;
- communicate effectively with the engineering community in writing and orally, using fluently at least another language of the European Union other than Italian.

REFERENCES

1. Modifiche al regolamento recante norme concernenti l'autonomia didattica degli atenei, approvato con decreto del Ministro dell'università e della ricerca scientifica e tecnologica 3 novembre 1999, № 509 [Electronic resource]: Decreto ministeriale 22 ott. 2004 № 270: pubbl. nella Gazzetta Ufficiale 12 nov. 2004 № 266 // Universita: [site] / Ministero dell'Istruzione, dell'Università e della Ricerca. – [S. l.], cop. 2009. – P. 3. – URL: http://www.miur.it/0006Menu_C/0012Docume/0098Normat/4640Modifi_cf2.htm, free. – Tit. from the tit. screen (usage date: 29.07.2013).
2. Determinazione delle classi delle lauree universitarie [Electronic resource] : Decreto ministeriale, Roma, 4 ag. 2000: pubbl. nella Gazzetta Ufficiale 19 ott. 2000 № 245 (Suppl. ordinario № 170) // Universita: [site] / Ministero dell'Istruzione, dell'Università e della Ricerca. – [S. l.], cop. 2009. – P. 4. – URL: http://www.miur.it/0002Univer/0021Offert/0093Classi/index_cf2.htm, free. – Tit. from the tit. screen (usage date: 29.07.2013).
3. Determinazione delle classi di laurea magistrale [Electronic resource]: Decreto ministeriale 16 mar. 2007, № 155: pubbl. nella Gazzetta Ufficiale del 9 lugl. 2007 № 155 // Atti Ministeriali : [site] / Ministero dell'Istruzione, dell'Università e della Ricerca. – [S. l.], cop. 2009. – P. 4. – URL: http://attiministeriali.miur.it/anno-2007/marzo/dm-16032007.aspx, free. – Tit. from the tit. screen (usage date: 29.07.2013).
4. EUR-ACE Framework Standards for the accreditation of engineering programmes [Electronic resource]: approv. by the ENAEE Administrative Council on 5 Nov. 2008 // EUR-ACE® Framework Standards / ENAEE : site. – [S. l] : ENAEE, cop. 2012. – P. 4–5. – URL: http://www.enaee.eu/wp-content/uploads/2012/01/EUR-ACE_Framework-Standards_2008-11-0511.pdf, free. – Tit. from the tit. screen (usage date: 29.07.2013).
5. By-laws of the Association Agenzia per la Certificazione della Qualità e l'Accreditamento EUR-ACE dei Corsi di studio in Ingegneria (QUACING) [Electronic resource] // Agenzia QUACING: site. – Roma, 2013. – P. 4. – URL: http://www.quacing.it/media/regolamento_en.pdf, free. – Tit. from the tit. screen (usage date: 29.07.2013).
6. Modello CRUI/EUR-ACE per la Certificazione della Qualità e l'Accreditamento EUR-ACE dei Corsi di Laurea e dei Corsi di Laurea Magistrale in Ingegneria [Electronic resource] / QUACING. – [Roma], 2011 (lugl.). – P. 5. – URL: http://www.quacing.it/media/Modello%20CRUI_EUR-ACE%20rev4.pdf, free. – Tit. from the tit. screen (usage date: 29.07.2013).

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Development of Independent Public Accreditation of Engineering Educational Programs in Russia in the 2000-2013 Timeframe

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Key words: *professional public accreditation, accreditation criteria, Federal Law "On Education".*

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The article presents the current overview of professional-public accreditation of engineering educational programs in the developed countries and describes the accreditation experience of AEER in Russia. Based on the conducted research and the decisions made at public hearings which were held in Saint-Petersburg, the amendments to the Federal Law "On Education", which are aimed at enhancing quality of engineering educational program accreditation in Russia, are proposed.

Independent professional-public or public-professional[1] accreditation of educational programs of any cycle and any specialty is an effective tool to control and ensure high quality standards of educational programs. It makes possible to escape the conflict of interests that can happen when educational program quality, its implementation conditions and learning outcomes are evaluated by state and affiliated bodies, as well as higher educational institutions (HEIs).

Accreditation of educational programs provides HEI with opportunities to:

- show loyalty to high quality standards of education and training;
- get an independent expert evaluation of educational programs and training quality;
- get recommendations for the improvement of educational programs;
- make a public announcement about reaching a high level of education quality;
- raise its competitive capacity on the Russian educational market;
- initiate the process of penetrating and developing the international education market;
- ensure and increase graduates' employment.

Such tool has been successfully applied in a number of developed countries, such as the USA, Great

[1] *In December 2012 the State Duma adopted Russian Federal Law "On education" that defines independent accreditation of educational programs as "professional-pubic accreditation" (article 96).*

Britain, Canada, Japan, Australia, for many years. It resulted in the development of national systems of independent public-professional accreditation of educational programs in engineering. The accrediting bodies are either private agencies or public organizations. Thus, ABET (the Accreditation Board for Engineering and Technology) was established in the USA, EngC (Engineering Council) – in Great Britain, JABEE (Japanese Accreditation Board of Engineering Education) works in Japan, Engineers Canada – in Canada. Being independent organizations, they, however, act with the approval of government and employers, and at the same time they are recognized by academic society (colleges and universities). In some countries the state's role is to keep register of the accrediting bodies.

The accrediting bodies representing national accrediting systems of educational engineering programs make international agreements on mutual recognition of accreditation criteria and procedures. It ensures globalization of engineering education, international recognition of accredited programs and thus, academic mobility development.

The most famous and reputable agreements of that kind are Washington Accord, (WA) is worldwide since 1988 [1], in Europe – the European Network for Accreditation of Engineering Education (ENAEE) was founded in 2004 [2]; in Asia – Asia-Pacific Quality Network (APQN) has existed since 2008 [3]. Washington Accord's full members are nowadays 15 countries: the USA, the UK, the Emerald Isle, Canada, Australia, New Zealand, Republic of South Africa, Japan, Hong Kong (China), Taiwan, Singapore, Korea, Turkey, Russia (represented by AEER); ENAEE association consists of 12 European countries: Germany, France, the UK, the Emerald Isle, Portugal, Russia, Turkey, Rumania, Italy, Poland, Spain, Switzerland; APQN includes 31 countries. Being a member of these alliances Association for Engineering Education in Russia (AEER) represents the Russian Federation as an independent public-professional accrediting body for engineering educational programs. The requirements to the accrediting bodies – members of WA and ENAEE as well as membership applicants – are very high, which actually provides international legitimacy of the accreditation processes.

Mutual monitoring system of accreditation procedures in the alliances' countries ensures high quality and fair evaluation of the programs under accreditation. In fact, membership in these alliances is similar to being included in the international register of quality assurance agencies. In Europe, there is also EQAR that actually is a register of European quality assurance agencies. However, most national accrediting agencies of Europe included in ENAEE (except ASIIN, Germany) are not EQAR's members. Nevertheless, they are recognized both in their own countries and in Europe.

Independent public-professional accreditation of engineering educational programs in Russia was initiated by Independent Accreditation Center (IAC) AEER founded by Nikolay Pavlovich Kalashnikov, professor of Moscow National Research Nuclear University "Mephi". Under his direction IAC has accredited some dozens of engineering educational programs in Russia. In 2000 Accreditation Center (AC) as a part of AEER was established. That was the beginning of the development of educational program accreditation criteria and procedures oriented to international requirements (at that time ABET and WA). At the same time, prof. Shadrikov V.D., member of Russian Academy of Education and at that time deputy minister of education, initiated the first efforts of Russia (AEER) to sign WA. The development of national system of public-professional accreditation of

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engineering educational programs in Russia became possible due to constant working contacts of AEER with the partners from WA and ENAEE member-countries. Pilot project "EURO-ACE" implemented in Russia significantly contributed to that process. It resulted in the development and implementation of AEER accreditation criteria and procedures that meet the requirements of European quality assurance agencies.

In 2005, AEER became a member of ENAEE. Being more experienced in educational program accreditation than other European accreditation agencies-ENAEE members, AEER is authorized to award EUR-ACE® quality label to educational programs of the first and second cycles for maximum 5 years.

As it was mentioned, during these years (2000-2013) AEER had close contacts with WA signatories. WA experts organized some seminars for Russian experts; they also monitored program accreditation procedures conducted by AEER in Russian Universities. WA vice-president, prof. Andrew Wo, took part in some of these monitoring visits. Due to this work AEER accreditation criteria and procedures were improved and reached the quality level to meet WA requirements. As a result, Russia (represented by AEER) became a WA signatory in 2007 as a Provisional member, and in 2012 as a Full member.

In general, the accreditation criteria and procedures applied by AEER are similar to those of WA signatories and ENAEE members and are fully recognized by them. In this connection AEER accreditation is international. Thus AEER accreditation certificate is signed by ENAEE president (nowadays –Iring Wasser) and by AEER president. (Fig. 1)

Fig. 1.


EUR-ACE ®
Accreditation of European Engineering Programmes

This is to certify that the programme

Electrical Equipment for Aircraft
140609 Электрооборудование летательных аппаратов

provided by

Moscow Power Engineering Institute (Technical University), Institute of Electrical Engineering

accredited by

the Russian Association for Engineering Education

on 27 March 2007 until 26 March 2012

satisfies the outcomes of Second Cycle programmes specified in

the EUR-ACE Framework Standards

for the Accreditation of Engineering Programmes,

and therefore for the above period of accreditation is designated as

a Second Cycle European Accredited Engineering Programme.

For the European Network for Accreditation of Engineering Education (ENAEE)

The President
Prof. Ing. Giuliano Augusti, Sc.D.

Brussels, 30 March 2007

For the Russian Association for Engineering Education (RAEE)

The President
Prof. Yuri Pokholkov, Sc.D.

Moscow, 27 March 2007

RU-000003

AEER criteria list [4] consists of 9 criteria that contain the basic requirements to accredited educational programs. They are:

Criterion1. Program objectives
Criterion 2. Program content
Criterion 3. Students and study process
Criterion 4. Faculty
Criterion 5. Professional qualifications
Criterion 6. Facilities
Criterion 7. Information infrastructures
Criterion 8. Finance and management
Criterion 9. Graduates

1. Program objectives

Program objectives should be in full correspondence with the state educational standards and meet the needs of potential consumers. They should be clearly stated and documented.

2. Program content

Program content should correspond to not less than 300 ECTS credits for Specialist's Degree programs, 240 ECTS credits for Bachelor's Degree programs and 120

ECTS credits for Master's Degree programs. The program curriculum should comply with the program objectives and ensure the achievement of the program outcomes.

3. Students and study process

The study process should provide the opportunities for all students to achieve the learning outcomes. Students should have internship opportunities in different enterprises and participation possibilities in academic mobility programs.

4. Faculty

Instructors and professors should be highly qualified, be engaged in research activities and realize the role of the disciplines in professional training.

5. Professional qualifications

The program should ensure engineering activity training during the whole study period. Graduates should have sufficient knowledge and skills in engineering disciplines, engineering analysis and design, etc.

6. Facilities

Facilities should meet the licensed indicators, be modern and adequate to the program objectives. They should be constantly updated and expanded.

7. Information infrastructures

The information base should be adequate to the program objectives and be constantly updated and enlarged.

8. Finance and management

Financial resources should meet the licensing indicators. Financial and management policies should be focused on the program quality improvement.

9. Graduates

The system of graduates' employment study and career support should be applied for further program improvement.

Figure 2 shows the data on AEER accrediting activity in Russian and Kazakhstan Universities. By now AEER has accredited 222 educational programs in 30 Russian and 7 Kazakhstan Universities. 141 of them were awarded with the international recognition label of ENAEE. The full list of accredited engineering educational programs is available on AEER site (www.aeer.ru).

Graduates of the accredited programs can be awarded with a special certificate, which allows them to apply for Russian and international certification authorities, such as SNIO, FEANI, IPEA, APEC, in order to be awarded with international certificate of professional engineer. At this moment AEER is a member of SNIO, APEC and IPEA and can submit graduates' data to these organizations at the wish of the graduates of the AEER accredited programs.

The system of independent public-professional accreditation of engineering educational programs is to be constantly ready to meet challenges, no matter where they come from: employers, state authorities, international or domestic academic community. Nowadays, the most crucial challenges for the system and AEER are the following:

1. There is no motivation for Universities to submit their educational programs for public-professional accreditation;
2. There is no internationally recognized national system of professional certification;
3. There is no law "On Engineering Qualification in Russia";
4. The Federal Law "On Education in the Russian Federation" №273-ФЗ 29.12.2012 (section 96) is inadequate.

The Federal Law "On Education" passed by the State Duma of the RF is the first in Russia to regulate public-professional accreditation of educational programs and higher educational institutions (article 96) [5]. Though regarding it as a positive step for civil society development in Russia, we have to state that the wording of the above mentioned law article was done carelessly and/or non-professionally. That led to contradictions in law interpretations and obstacles for public and professional accreditation associations. In general it seems that the authors of the law are not familiar with international and domestic experience of independent public accreditation procedures.

In this connection, on May 28, 2013 AEER initiated public hearing "Professional-Public Accreditation of Engineering Educational Programs" (St. Petersburg) for analyzing and discussing the content of the article 96 of the Federal Law "On Education": Professional-Public Accreditation of Higher Educational Institutions, Professional-Public Accreditation of Educational Programs. The hearing resulted in couching proposals that may be used as amendments to the Law "On Education".

Initiators of the hearing were AEER and National Research Polytechnic Universities of Tomsk and St. Petersburg. The hearing took place in St. Petersburg State Polytechnic University. Representatives of employers, academic society and the Federation Council actively participated there. The detailed information on the hearings is available on AEER site [6].

The content analysis of article 96 and the proposals on its amendment are the following:

Provision 1

"Educational institutions can be accredited by different Russian, foreign and international accreditation organizations".

It allows any organizations of any level and status to act as an accrediting body.

Proposal:

"Educational institutions can receive public accreditation by Russian, foreign and international public (professional) organizations that are included in National or/and international registers of accrediting bodies".

Provision 2

"Public accreditation is regarded as recognition of the fact that educational institution's activity meets the requirements and criteria of Russian, foreign and international bodies".

"Accreditation procedure, evaluation methods and forms as well as the rights given to an accredited educational institution are regulated by a public body conducting accreditation".

The requirements to the status and level of the accrediting body are not specified. A public organization cannot give any rights to an accredited organization.

Proposal:

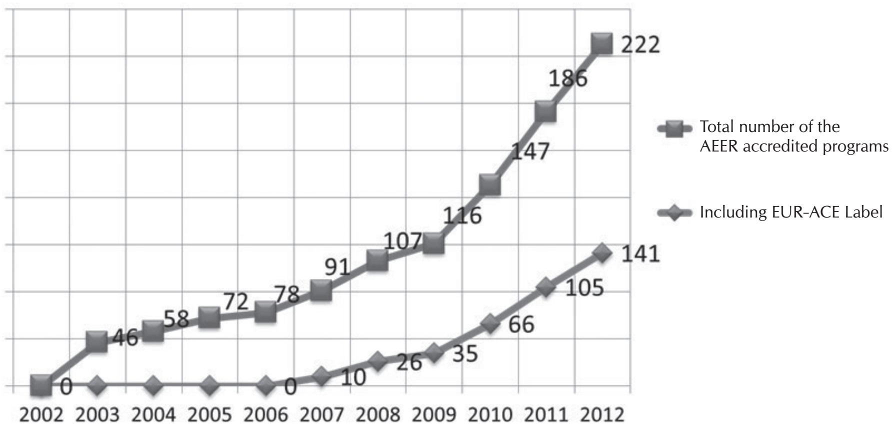
"Public accreditation is regarded as recognition of the fact that educational institution's activity meets the requirements and criteria of Russian, foreign and international bodies that are included in National or/and international registers of accrediting bodies".

"Accreditation procedure, evaluation methods and forms as well as public status of an accredited educational institution are regulated by a public body conducting the public accreditation".

Provision 3

"Employers and their associations, as well as authorized organizations have the rights to conduct public-professional accreditation of

Fig. 2. Dynamics of AEER Engineering Educational Program Accrediting Activity (2002-2012 years)



professional educational programs of a higher educational institution".

Proposal:
"Employers and their associations, as well as authorized organizations have the rights to conduct national or/and international public-professional accreditation of professional educational programs of a higher educational institution in case they (employers and their associations, as well as authorized organizations) are included in national or/and international registers of accrediting bodies".

Provision 6

"Educational program accreditation procedure, evaluation methods and forms as well as the rights given to an educational institution implementing the accredited educational program or to graduates of the accredited programs are regulated by the employers and their associations, as well as authorized organizations that conduct the accreditation".

Proposal:
"Educational program public-professional accreditation procedure, evaluation methods and forms as well as the public status given to an educational institution implementing the accredited educational program or to graduates of the accredited programs are regulated by the employers and their associations, as well as authorized organizations that conduct the accreditation".

Provision 8

"Information on the public or professional-public accreditation status of an educational institution is sent to the accreditation body and shall be regarded during state accreditation".

Proposal:
"Information on the public or professional-public accreditation status of an educational institution is sent to the state accreditation body and is recognized inter alia qualitative indicators during the state accreditation of the educational institution and while establishing quota for state-

funded places for domestic and foreign students".

Provision 9

"National and international public university accreditation and professional-public accreditation of educational programs are conducted on a voluntary basis".

Proposal:
"National and international public university accreditation and professional-public accreditation of educational programs are conducted on a voluntary basis. The State encourages universities to receive national and international professional-public accreditation of educational programs by devoting funds to state educational institutions for educational program improvement to make the programs meet the requirements of national and international accreditation bodies and for covering accreditation expenses".

Conclusion

Independent public or professional-public accreditation of educational institutions and programs is an effective tool to control quality of professional training. In Russia, such system has been successfully developed over the past few decades by such associations as AEER, NCPA and AKKORK. Thus, the accreditation criteria and procedures applied by AEER are recognized by the most famous and reputable international alliances, which makes AEER accreditation status to be international. The experience accumulated by Russian accreditation organizations can definitely serve as a basis for the Russian laws that regulate the processes of public and professional-public accreditation in education.

REFERENCES

1. Washington Accord [Electronic resource]: offic. site / Int. eng. alliance – [S. l., 2012]. – URL: http://www.washingtonaccord.org/Washington-Accord/signatories.cfm, free. – Tit. from the screen (usage date: 23.08.2013).
2. European Network for Accreditation of Engineering Education [Electronic resource]: offic. site. – [S. l.]: cop. ENAEE, 2012. – URL: http://www.enaee.eu, free. – Tit. from the screen (usage date: 23.08.2013).
3. Asia-Pacific Quality Network [Electronic resource]: offic. site. – [S. l.]: cop. APQN, 2013. – URL: http://www.apqn.org/, free. – Tit. from the screen (usage date: 23.08.2013).
4. Accreditation Criteria and Procedure for Educational Programs of the First Cycle [Electronic resource]: approved by AEER Board 29.12.2011. – 15 p. - URL: www.ac-raee.ru/files/criteria/kriterii-1-2011.doc, free. – Tit. from the screen (reference date: 29.07.2013).
5. On Education in the Russian Federation [Electronic resource]: The Russian Federation Federal Law 29.12.2012 №273 –FL// Russian Newspaper. – 2012. – December, 31 (№5976). – Electronic version. – URL: http://www.rg.ru/2012/12/30/obrazovanie-dok.html, free. – Tit. from the screen (reference date: 25.08.2013).
6. Public Hearings "Professional-Public Accreditation of Engineering Educational Programs" [Electronic resource] [May, 28. 2013, St. Petersburg]: the results of the hearings//AEER office. site. – [M.]: AEER, 2013. - URL: http://aeer.ru/ru/hearing_2013-mater.htm, free. – Tit. from the screen (reference date: 25.08.2013).

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New Education Legislative Act as Development Vector of Public-Professional Accreditation in Russia

National Center of Public-Professional Accreditation
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Key words: *public accreditation, International accreditation, Joint accreditation, an expert organization, an accreditation agency, register of the accreditation agences.*

Due to the adoption of new Federal Law "On Education in RF", public-professional accreditation is becoming urgent issue in contemporary education system. The article examines the concepts of public-professional accreditation, international accreditation and joint accreditation. Based on the legislation system, expert organizations and accreditation agencies are classified according to their objectives and activity areas. The ways to develop accreditation network and register of organizations involved in higher education quality assurance have been proposed.

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The concept and procedure of governmental accreditation for exclusively all education institutions were introduced into the Russian legislation in 1992 [1]. The following TRIAD: state education standard – governmental accreditation – state diploma (or other state-recognized document) was entrenched into the law. However, during the last two decades, this "rock-solid" triad was gradually crumbling down: brick-by-brick and the new law "Education in the Russian Federation" prescribes new variants.

At present accreditation status within governmental accreditation will not be assigned to higher education institutions, in general (including education institutions) but, now, this accreditation will be assigned relevant to each level and integrated speciality group and/or degree program. In this case, this document of education will not be necessarily governmental [2 (Article 60, §4)]. Federal state standards will be specified for basic education programs which include higher education programs – bachelor's degree, specialist's degree, master's degree and post-graduate programs (graduate military, clinical studies).

The Legislation of 1992 legalized the right of higher education institutions to pass public-professional accreditation, but, in this case, excluded the legal rights and obligations of a state accreditation. State accreditation became an obligatory procedure, while public accreditation – permissible.

In accordance with the Russian Legislation of 2012, information of state and/or public-professional accreditation is officially submitted to the state accreditation agency and is liable to be considered in the case of state accreditation of education institutions. From the viewpoint of legal language ("de rigore juris") this or that education institution should submit the results of public-professional accreditation to state accreditation agency, which, in its turn, should consider all presented material. Posing such a question, it indicates those changes in the state education policy, concerning quality assurance in education itself.

Interested communities, from top public officials to employers, are more and more considering the development of publicl-professional accreditation. The reason is very simple – for the past 20 years there has been a significant education boom: the number of the education institutions has increased twice, while the number of students and education programs-threefold. Education itself has become more accessible and highly in-demand. All in all, this prompted such negative aspects as the upspring of malinstitutions, implementation of low-quality education programs, non-competitiveness and non-demand of such graduates. Top public officials highlighted quality of education programs in juridical and economic specialties, as well as, in management and sociology [3,4].

Another important fact is that enrollees, employers and academic communities, all of whom, require unbiased information concerning the quality of this or that education program, but not of the university in general. To a greater or lesser extent, public-professional accreditation is focused on the detailed examination and evaluation of the program, through expert commentaries, instead of simple normative standard analysis of faculty qualification, computer resources, library resources and courseware, lab areas, etc.

Innovation development strategy in Russia up to 2012 (Government Executive Order RF-№ 2227-р was enacted from December 8, 2011) involved the need in developing an innovative economy, which, in its turn, requires the advanced development of the education system and significant improvement of quality assurance in education .

The updated Federal law "Education in the Russian Federation", enforced from September 1, 2013 and the State program "Education Development" for 2013-2020 recognize the social significance of public-professional structure development for quality assurance in education. Executive authorities are interested in obtaining autonomous evaluation and quality assurance in education from public organizations and professional societies. The task: "The development of a system of evaluation and quality assurance in education and demand of education services" involves not only the solution of this task, but also the generation of such conditions to further the state and public evaluation of education institutions and public-professional accreditation of education programs.

Nowadays, public-professional accreditation is conducted through those organizations established by public and/or professional associations and societies. Such accreditation is more significant in enhancing the prestige of education programs and education institutions than those of state accreditation as public-professional accreditation involve a higher level of quality requirements to education. Such high – level standards, however, do not pursue retributive (supervisory and monitoring) purposes. The mission of the organization conducting public-professional accreditation embraces support services, identification of further development prospects of this/that education institution and stating the possible opportunities in improving the education potential.

The growing number of universities and their education programs submitted to public-professional accreditation agencies is evidence of the reliable support policy for higher education institutions. Although such public evaluation of education programs entails no government financing or additional rights and privileges, it promotes the attractiveness of these institutions for enrollees and employer demand of future graduates.

Public-professional accreditation does not duplicate the procedures and standards of state accreditation, as professional and public associations are justified to develop its own standards in evaluating education programs. Today Russian accreditation agencies use European standards of education (engineering) program evaluation, and in some cases-American standards. This can be explained by the following facts; (1) Russia has become a participant of integrated education processes in the harmonization of the higher education structure; (2) Russia is applying unified principles in the organization of the teaching process and (3) Russia is applying common European standards for quality assurance in education [5].

Russian legislation promotes the possibility to obtain public accreditation in foreign and international organizations. Moreover, one of the top priority areas in the development of domestic higher education organizations, especially federal and national research universities, is their global ranking, as well as, the public accreditation of education programs.

"International" accreditation registration does not imply that it will be acknowledged in all countries abroad. However, in the case, if an international accreditation agency is accredited by other international association agencies for quality assurance in education, the recognition of such an organization is of high prestige for any university and certifies the relevance of the quality of education programs to high international standards.

Thus, such an organization is European Association for Quality Assurance in Higher Education (ENQA) for European countries, including Russia as a member of Bologna process. European Quality Assurance Register (EQAR) maintains the information of certified agencies in Europe. There are no public accreditation agencies in Russia which are included in the above-mentioned Register.

Without doubt, the concept "international accreditation" is nominal as this embraces only the accreditation of particular programs in Russian universities by one of the international accreditation agencies. That is, any agency in any country is not compelled to acknowledge the results of this or that accreditation.

Registration of accredited education programs in recognized international accreditation agencies is not only prestigious for a university, but also is often necessary, especially, in the case of university collaboration with international education institutions; as well as, the implementation of joint diploma programs which are recognized in both countries – Russia and university partners.

Implementation of networking education programs, including joint programs with foreign education institutions were legislated in the updated law [2 (Article 15, §1)] and the issue of accreditation of such networking joint programs is becoming urgent. Such programs are accredited in collaboration with Russian and foreign accreditation agencies in accordance with standards and unified commission of Russian and foreign experts. Joint accreditation reduces the number of accreditation procedures and excludes nostrification of such university degrees.

Nowadays, joint accreditation of education programs generates interest and relevance for European universities, where more and more joint programs are being implemented. These education programs are developed and implemented by 2 or even 3 universities of different countries within the framework of international projects and/ or interuniversity agreements. Completing such programs the graduates receive joint diplomas which are recognized in 2-3 European countries without further nostrification of such university degrees.

At present only "double-degree" programs are being implemented in Russia, which, in its turn, means that a graduate simultaneously receives two diplomas: Russian diploma and diploma of university-partner. At the same time, however, one and the same program being implemented in two different universities should be accredited in accordance with the standard requirements of each country. However, state accreditation is obligatory for Russian education institutions.

Joint accreditation is possible only in the case of interaction between international accreditation agency and public accreditation agency within Russia. State accreditation cannot be carried out in cooperation with international accreditation agencies as it insures the compliance of educational programs to Russian Federal education standards and is applied not to a particular educational program, but to all educational programs provided by University. Joint accreditation of education programs by foreign and Russian agencies in public-professional accreditation can be considered and acknowledged in the process of state accreditation.

Nowadays, in Russia public-professional accreditation is conducted by several organizations, each of which has its own specification and activity domain.

Since 2010 National Center for Public Accreditation (NCPA) conducts public-professional accreditation in compliance with European standards and technologies. This Center has experience in conducting joint accreditation. This accreditation of education programs involves self-study report for a joint expert commission review, expert commission visit and preparation of expert recommendations, accreditation registration and publication of accreditation results in mass media (www. accreditation.rf).

A specific feature and important criterion of accreditation in NCPA is public recognition of this or that program based on the national project results of "Best Education Program in Innovative Russia"[6]. Public recognition involves the results of internet-questionnaire of academic communities and professional associations.

The next step – evaluation of education programs by a special expert commission with host visit. The expert commission includes representatives of Russian university community, name and recognition in the academic and scientific communities (members of Guild experts in professional education domain), foreign experts, employers and student communities. Such a commission entertains the opinion of all interested parties and presents objective and independent evaluation of the program.
Besides, an important feature of public-professional accreditation is that the commission includes professionals with academic degrees and/or ranks, solid in a University, acknowledgement of scientific publications. Only these experts have the corresponding qualifications to evaluate the quality assurance in education programs, to recommend all necessary improvements and to confirm the achievements and quality of the program. Decision of public-professional accreditation is rendered

by the collegiate board of Guild experts and NCPA.

Joint accreditation is conducted by NCPA in collaboration with established European quality assurance agency, pertaining to existing standards. The commission includes representatives of Russian and foreign university communities who have been elected by accreditation agencies, as well as employers and students. The accreditation results include joint expert conclusion and decision of two collegiate agencies from both parties. All documents of public-professional and joint accreditation procedures (self-study reports and external expertise) are available for public in two languages – Russian and English. These procedures are objective and self-supporting.

Every existing accreditation agency is governed by specific targets and at the same time develops individual evaluation tools. Considering the new state education policy in supporting the procedure of public-professional (professional-public) accreditation, the number of organizations evaluating education programs will increase. In this respect, emerges the demand in promoting an effective interaction of all interested parties, associated with accreditation procedures: accreditation agencies, state education authorities, public and professional associations and societies, and education institutions.

Two new concepts "expert organization" 2 (Article 92, §13)] and "authorized organization" [2 (Article 96, §3)] have been introduced in the new law "Education in the Russian Federation". These concepts embrace those organizations included in the education system, as well as education organizations and regulatory agencies. Expert organizations can be involved in state accreditation. Organizations, authorized professional and public associations, conduct public-professional accreditation. Expert organizations follow procedures, expertise forms and methods specified for state accreditation and determine the interrelation of training content and quality of students and graduates to the requirements of federal education standards. "Authorized organizations" have the rights to establish the forms and expertise methods for quality assurance of graduates in accordance to the requirements of professional standards and labor market.

Thus, the new legislation is beyond the scope of the state regulation of education institution activities and envisages the participation of professional communities in quality assurance for received education. However, there are unsolved problems concerning the activities of engaged expert and authorized organizations.

The question arises – if expert organizations use evaluation tools for education standards, while authorized organizations – evaluation tools for professional standards, then what standards are relevant for universities? In this case, education standards and professional standards are quite different.

What is the legal structure of such expert and authorized organizations and what requirements should they comply with? In international practice these requirements are toughly detailed: this organization should be only a non-profit organization, i.e. not deriving any profit. This organization should be independent of any influence of third parties, i.e. not be related to any state authorities and / or individual education institution; should have self-sustained resources for the implementation of assigned tasks; and periodically going through accreditation procedures within state and / or public organizations.

In world practice, there prevails the so-called procedure "accreditation of accredited agencies". For example, the establishment of European Quality Assurance Register (EQAR), which was initiated by European public associations and government agencies of Bologna country-members within the framework of the European Higher Education Area (EHEA)? In the USA accreditation agencies go through this procedure in the non-government agency – Council for Higher Education Accreditation (CHEA), which was established by the accreditation agencies personally, and government – US Department of Education.

The review analysis of world experience indicates the fact that there should be several accreditation agencies for large countries, even for such a centralized country as Russia. Why? - if the task is: effective and objective quality assurance for education. How many agencies should there be, and should they be established according to the profile principle or territorial principle-it remains to be seen. However, one should take into consideration the possible emergence of commercial or malorganizations, the so-called “in-line processing factory of accreditation certificates” within the accreditation domain. Such examples can be found in Russia and abroad. To avoid and exclude such incidents, it is necessary to establish non-governmental self-organizing network (association) of accreditation agencies. The task of such an association would be the Code of Good Practice (for example, “Standards and Recommendations for Quality Assurance System in European Higher Education Area”, developed by the European Association for Quality Assurance in Higher Education-ENQA).

New law enforcement in Russia would ultimately introduce amendments in the work of existing accreditation agencies. It is quite obvious that well-defined cooperation objectives in the education quality expertise domain for domestic education system are necessary [7].

Taking into account the existing accreditation experience in Russia and abroad, as well as the requirements for new legislation laws in state accreditation (including monitoring and supervisory procedures), more and more expert organizations will be involved. In this case all requirements will be developed by the federal executive agency, responsible for the monitoring and supervision in the education domain. In compliance with Article 92, §14 of the Law, this agency will maintain a register of expert organizations.

The situation is quite different in the case of “authorized organizations.” Not in every sector of economy and production do exist employer associations, are developed professional standards and are defined the market requirements to specialists, workers and personnel of this or that profile” [2 (Article 96, §4)]. Another serious problem is the employer’s relationship to his / her interaction with the education system in the sphere of quality assurance for education and their personal professionalism in expert activities.

The way out is to establish an association of accreditation agencies with developed code of good practice approach and focused-activities in estimating close interactions with existing and emerging employer associations and societies. In accordance with new law requirements, public-professional accreditation is not regulated by the executive agency responsible for the monitoring and supervision in the education domain; and, in this case, it is practically impossible to establish a unified association of employers. Thus, the register of good practice accreditation agencies should be in the hands of the association of accreditation agencies through established rules and procedures, which, in its turn, ensures the availability and transparency of all information concerning the activities of such an association.

This path of accreditation practice in the Russian education system will be based on the following factors: integration tendencies into the Russian-European Higher Education Area, the shaping of government-public partnership in education management, new state education policy, transparent and recognized by Russian and foreign communities.

REFERENCES:

1. Navodnov, V., Gevorkayn, E., Motova, G., Petropalovski,M. (2008) Accreditation of Higher Education Institutions in Russia. Manual. Ioshkan Ola: Mariiski State Technical University, 166 p.
2. Federal Law "Education in the Russian Federation" N 273-ФЗ from December 29, 2012.
3. Russian Federation Presidential Decree № 599 of May 26, 2009 "Procedures in Improving Higher Juridical Education in RF".
4. Russian Federation Presidential Decree № 599 of May 26, 2009 "Procedures in the Implementation of State Policy in Education and Science".
5. Motova, G., PykkÖ, R. Russian Higher Education and European Standards of Quality Assurance / G. Motova, R. Pykkö // European Journal of Education/ Special Issue: Russian Higher Education and the Post-Soviet Transition, Volume 47, Issue 1, March 2012, P. 25–36.
6. Bolotov, V., Navodnov, V., Motova, G., Saricheva, T. (2013) Project "Best Education Programs in Innovative Russia"// Higher Education Today № 4, P. 5-13.
7. Navodnov, V., Motova, G. (2010) Accreditation: Reloading? // Accreditation in Education № 40, P. 49-51.

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Basic Principles of Public-Professional Accreditation of Educational Programs

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Key words: *public professional accreditation, university degree programs, basic principles.*

The article analyzes basic principle for organizing and carrying out public-professional accreditation of university degree program submitted by technical higher education institutions.

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Being in progress, national higher education systems naturally aim at meeting the so-called "world standards" developed by the international scientific and technical society. Public-professional accreditation of educational programs (EP) for higher professional education is one of the effective means to achieve these standards and to provide conformity evaluation [1].

EP public-professional accreditation is quite a complicated and crucial process. In different countries it is carried out by means of different accrediting organizations (bodies) in different ways, which is based on peculiar rules and principles [2,3,4]. Nevertheless, despite the differences and peculiarities, there is a system of basic principles of public-professional accreditation procedure or EP external independent assessment that was developed as a result of interaction between national systems and foundation of international united accreditation bodies that made a great input in standardizing EP accreditation criteria and procedures.

Let us specify in advance that the article deals mainly with accreditation of engineering educational programs that are university degree programs (UDP) in engineering.

Thus, in general, we can say that public-professional accreditation of university degree programs in engineering is based on the following principles:

1. Voluntary principle.

Universities participate in UDP accreditation of their own accord. There are no laws or regulations making them take part in this quite a labour-intensive and stressful process. The only thing that encourages universities to have their degree programs independently evaluated is a number of stimuli. These stimuli arise from the environment (often quite competitive one) where universities carry on their educational activity. The stimuli can be different in different countries. Thus, in Canada, only graduates of accredited degree programs can further apply for "Professional Engineer" status. That means that non-accredited degree programs are not in demand on the Canadian educational market [5]. There are not such stimuli in Russia yet. The basic reason for

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domestic universities to participate in this process is the ambitious wish of leading universities to manifest their adherence to high quality engineering education and to have an independent confirmation of the right direction of their development.

2. Recurrence principle.

University degree programs (UDPs) are not accredited "forever and ever". As a rule, the programs are accredited for 4-5 years, after that the program is supposed to be accredited again. Some UDPs are accredited for a shorter time period, which is caused by a number of unsatisfactory features defined by the expert group. It is natural that the accredited program can progress according to the principle of "continuous improvement", as well as the accreditation criteria can be updated as time goes by.

3. Principle of experts' independence.

In all the countries where EP public-professional accreditation system exists it is based on independent evaluation conducted by independent experts. As a rule, these are industry and academic representatives, and the latter constitutes the majority of the examination team. Sometimes international monitors (representatives of international accreditation agencies) can be included in the examination team. In some countries, for example Lithuania, the examination teams consist only of foreign specialists [6]. The important point is that before the accreditation procedure each expert signs the statement for no-conflict of interests that states no personal interest in the program accreditation and no relations with the higher educational institution (HEI) or the UDP being accredited. During the accreditation procedure all the decisions on compliance or noncompliance of the program with the accreditation criteria are taken on a collegiate basis. Nevertheless, every expert has the right to attach his/her special opinion to the evaluation report if he/she disagrees with the colleges' opinion on this or that UDP aspect.

4. Principle of accrediting agency's independence.

An accreditation body should be independent on state and municipal authorities and political structures, as well as sponsors. This condition is strictly controlled by international associations of accrediting agencies (and national accrediting bodies are interested in their international recognition through membership in such associations). A good example is European Quality Assurance Register for Higher Education (EQAR) [7] that requires all agencies to comply substantially with the European Standards and Guidelines for Quality Assurance (ESG) to be admitted to the Register [8].

Accreditation criteria design and change, accreditation procedure and decision-making on accrediting /non-accrediting particular UDPs – all this is the right and responsibility of the accrediting body and shouldn't be coordinated or approved by any other organizations including sponsors.

All the decisions on accrediting procedure and criteria as well as on the results of particular program evaluation are taken by an elected board of accrediting agencies. Besides, an accrediting body, being a legal body, should manage its funds.

5. Principle of the declared accrediting subject area.

Accrediting bodies can carry out independent evaluation of the UDPs that belong to the declared subject area (for example, engineering education, that is the field of technologies and technique) and declared types of degree programs (for example, professional education programs awarding Bachelor's, Master's and Specialist's Degrees). Obviously the accrediting subject area can and should be enlarged, for example it is necessary to develop accrediting procedure and criteria for advanced educational programs. In any case the UDPs submitted by HEIs should correspond to the declared accrediting subject area. It is not mere chance that the international accrediting associations are restricted by particular subject areas.

6. Transparency principle.

To comply with this principle means that all information about accrediting criteria, procedure, rules of decision-making and other methodical materials should be available for a wide interested public. But it doesn't mean that the self-study materials submitted to the Accrediting Board by the HEI, as well as evaluation report made by the examination team should be at the disposal. As a rule, such sort of information is confidential one and can be available for interested parties when approved by all parties involved (first of all, HEI and Accrediting body).

7. Principle of common goal of UDP accrediting procedure.

Any activity involving social interests (in our case, academic society) should set goals and be guided by them in practical activities. These goals should be common for all participants of the process; otherwise there might be a conflict of the parties involved.

The common goals of accrediting UDPs (or being accredited) are:

- to promote (in professional and academic society) the best educational technologies for professional training of UDP graduates by developing and implementing high quality educational standards;
- to inform all interested parties and the society as a whole about UDP public recognition that proves its compliance with standard quality requirements;
- to encourage HEI top managers to monitor UDP quality and to improve them constantly.

8. Principle of respect, partnership and mutual interests.

UDP accreditation procedure and criteria should recognize particular features and diversity of HEIs and the degree programs they implement as well as encourage academic creativity and innovation in educational process. After all, the term "accreditation" comes from Latin "credo" (trust). It is natural that HEIs differ in their possibilities, ambitions, aims and potential. High level of the accreditation requirements does not mean that one size should fit all universities interested in degree program accreditation.

Accreditation criteria should be mostly of qualitative character. They should evaluate the degree of program goal achievement taking into account particular features of HEIs, their missions, development strategies, strengths and weaknesses. Besides, the accreditation criteria should be quite flexible, they should not have restrictive and regulatory character. Moreover, they should take into account possible diversity in approaches, methodics and ideas used by HEIs while implementing educational programs and ensure possibilities of EP changes and continuous improvement.

The interaction between the accreditation body and HEI submitting DPs should be based on the principle of mutual interest in fair and objective evaluation of UDPs. Only such partner character of the stakeholders' interaction can result in effective work and mutual benefits, which contribute to the development of the educational system as a whole.

REFERENCES:

1. Gerasimov S.I. Development of Professional-and-Public Accreditation Systems for Educational Programs in Russia and Abroad/ S.I. Gerasimov, S.O. Shaposhnikov// Quality. Innovation. Education. – 2012. - №12. – P. 36-43. (only in Russian)
2. Principles of Accreditation [Electronic resource] // The American Speech-Language-Hearing Association (ASHA): [the offic. site]. – Rockville, 1997–2013. – URL: http://www.asha.org/academic/accreditation/PrinciplesAccreditation, free. – Tit. from the screen (usage date: 22.07.2013).
3. Principles of Accreditation: Foundations for Quality Enhancement [Electronic resource]: approv. by the College Delegate Assembly, Dec. 2001 / Commiss. on Colleges South. Assoc. of Colleges and Schools (CACS COC). – 1st ed., 1st print. – Decatur, cop. 2004. – 44 p. – URL: http://www.sacscoc.org/pdf/PrinciplesOfAccreditation.PDF, free. – Tit. from the tit. screen (usage date: 22.07.2013).
4. Accreditation Manual [Electronic resource] (for evaluation visits after August 2011) / Inst. Eng. Singapore; Eng. Accred. Board. – Singapore, 2011. – 26 p. – URL: http://www.ies.org.sg/professional/eab/eabman.pdf, free. – Tit. from the tit. screen (usage date: 22.07.2013).
5. Shaposhnikov S.O. Accreditation of Engineering Programs in Canada// Accreditation in Education. – 2010. -№1(36). – P. 36-41
6. Shaposhnikov S.O. Review of Accreditation of Engineering Programs in Lithuania// Engineering education. – 2012. -№9. – P. 40-45
7. European Quality Assurance Register for Higher Education [Electronic resource]: [the offic. site]. – [Brussels, 2013]. – URL: http://www.eqar.eu, free. – Tit. from the screen (usage date: 22.07.2013).
8. Standards and Recommendations for Higher Education Quality Guarantee in European Area/The European Association for Quality Assurance in Higher Education. Accreditation in education, 2008. – 58 p. – [Electronic resource] – URL: http://www.enqa.eu/files/ESG_Russian%20version.pdf, free. – Title from the screen (reference date: 22.07.2013).

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Standard Interview Questions for Educational Program Accreditation in the Association for Engineering Education of Russia

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Key words: *interview, program objectives, learning outcomes.*

The authors analyze standard questions asked by AEER experts to students, teachers, employers, faculty authorities while visiting universities to evaluate the achievements of educational program learning outcomes.

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Nowadays international requirements for recognition of final higher engineering education documents are increasing in all the countries involved in the integrating processes [1]. It becomes obvious that the formal integration achieved by prior conventions is not enough for increasing education quality. It is necessary not only to recognize the educational results (diploma, degree, qualification), but also to give credit (to credo) to the process (teaching process, internship, project work). It is necessary to interfere and influence the internal processes of Universities, that is on the basic educational triad: "what to teach, how to teach, and who teaches" [2]. One of the ways to evaluate the university's activities in educational quality improvement is professional-and-public accreditation of educational programs. Association of Engineering Education in Russia was one of the first organizations that started professional research of that problem [3]. Accreditation Center is a department of the Association for Engineering Education of Russia (AEER). It fulfills the initial analysis of educational programs, analyzes self-study report of universities, organizes experts' visits to the universities, and makes reports on educational program evaluation for AEER Accreditation Board [4].

Experts of the AEER Accreditation Center (AC AEER) are the basis of AC efficiency and the icon of modern engineering education in Russia. More than 200 certified professionals – deans, heads of divisions and departments, professors, associate professors, industry and authority representatives provide benefit to their jobs participating in AEER activities [5].

Most of the AC AEER experts start their career as a member of a team examining educational programs during their visits to universities.

AEER Accreditation Criteria

The Accreditation Center provides the higher education institution with the latest version of the criteria and self-study questionnaires for the university to carry out a self-study process according to the AEER requirements [4]. These criteria correspond with the requirements of all international accreditation agencies included into ENAEE and Washington Accord [6, 7]. If all nine requirements are met, a program is awarded with EUR-ACE® quality label (accredited engineer). In fact, before and during his/her visiting the university the expert gives a reasoned answer to the questions presented in the right column of the table [8].

On-site visit

It starts with the experts' meeting at a hotel and ends when all the members of the examination team leave a higher education institution (HEI) after completing all the work according to the plan.

At this stage the aims of the expert teams are:

1. To give qualitative and quantitative evaluation of the factors that cannot be reflected in the written documentaries.
2. To make a study of documents and reports prepared by the HEI for accreditation.

Table 1. AEER Criteria, Brief Content

Criterion	Content
1. Program objectives	Are the program objectives in full correspondence with the institution mission and the needs of potential consumers?
2. Program content	Do the learning outcomes correspond with the program criteria and objectives?
3. Students and study process	Обеспечивает ли учебный процесс достижение результатов обучения? Имеют ли студенты, зачисляемые на образовательную программу, информацию о планируемых результатах обучения и возможности их достижения в нормативное время?
4. Faculty	Does the faculty meet the requirements to ensure the achievement of the corresponding learning outcomes?
5. Professional qualifications	
6. Facilities	Are classrooms, laboratories, and associated equipment modern and adequate enough to meet the program objectives?
7. Information infrastructures	Are computer labs, libraries and other information accesses adequate enough to meet the requirements of the program objectives?
8. Finance and management	Are the financial resources, administration and management of the program (faculty/department) efficient enough to meet the program objectives?
9. Graduates	Do the graduates' job positions and careers correspond with their qualification?

3. The industry representative should pay special attention to the graduates' ability to perform their professional functions and the degree of their skills and competencies development to meet modern requirements of potential consumers.

4. To make a report for HEI on its strengths and weaknesses.

Participants:

1. HEI representatives including university and faculty leaders, faculty involved in the accredited program implementation, and supporting staff.

2. Students admitted for the program.

3. Members of the examination team.

The educational program audit involves meetings of the examination team members with:

- Students.
- Faculty.

The experts interview students in the absences of faculty and university/faculty leaders.

The experts interview faculty in the absence of university/faculty leaders.

During such meetings the experts can ask the following typical interview questions.

Head of the department which offers the educational program under consideration

- Is there a plan of the program improving? (Ask a copy if it was not included in the self-study documents or given materials).
- What are the program objectives and do they differ from the objectives stated in the self-study documents?
- What are the learning outcomes and do they differ from those stated in the self-study documents?
- Do the learning outcomes meet the AEER criteria? Are there any changes with regard to the self-study materials?
- What is your role in program goal setting and definition of learning outcomes?
- What is your involvement in the evaluation of the goal and learning outcomes achievement?
- Does the program curriculum ensure the learning outcomes achievement?
- How do the learning outcomes ensure the achievement of the program objectives?
- What changes have been made in the program as a result of your evaluation?
- How do you know that the graduates have achieved the required learning outcomes?
- In what way are you involved in the program changes?
- How can the faculty (teaching staff) ensure the goal and learning outcomes achievement?
- How successful are your graduates: job positions, starting salary, job career, etc.?
- How active are your employers?
- What program changes have been made to meet their requirements and suggestions?
- What are strengths and weaknesses of your and supporting departments?
- Are you planning any global changes in the curriculum? What and when?
- What needs and requirements should be ensured for the curriculum development?
- Do you manage the budget? In what way?
- Do you recommend on salaries of your department faculty and their job promotion?
- How much time is available for your faculty for their professional development?
- What does your faculty do during summer months?

- Who is responsible for confirming that the graduates fulfilled all the requirements before being awarded with the diplomas?
- What is the procedure of ECTS credits recognition in case of academic mobility, discipline change, etc.?

Faculty

- What program objectives and learning outcomes are developed or achieved by means of your subject?
- Are you involved in evaluating and updating of program objectives and learning outcomes? What way?
- Is any help in professional development available for you?
- How much time do you spend on professional development?
- What professional associations do you belong to? Are you really an active member of professional associations? Do you support professional society or are you an official establishment?
- What do you do for obtaining necessary laboratory equipment?
- Are lectures and laboratory classes taught by one instructor? If not how do they interact?
- Is the salary structure really satisfying? What bonuses and benefits are included?
- What unique or unusual teaching methods are used in your department?
- How do employers influence the educational program?
- What is the procedure of the curriculum change?
- Do you have regular contacts with the industry /employers? What way?
- What changes should be done to improve the program?
- Do the supporting departments ensure the required education level for your students?
- Is office and technical service at your full disposal?
- How much time do you spend in class? In lectures? In laboratories?
- What is the average number of teaching hours per week for your position (full time)?
- What is your teaching qualification level in the program? Evaluate yourself.
- What is your experience in the industry related to the program?
- Are you involved in planning constant improvement of the program?
- How does this improvement plan influence the curriculum?
- Do you have and use this plan in your work? How?

Employers/Industry representatives

- How often do the employers meet with the head of the department?
- What do they meet for?
- Do the employers give advice to the department on program objective development, the ways to achieve and evaluate them?
- Do the employers consider current and potential technical requirements that the program graduates are to face?
- Are the employers involved in the development of the program objectives? How do they do it if involved?
- Are you involved in evaluation of the program results?
- Have there been any changes in the educational program due to employers' participation in program improvement? If yes, what were these changes?
- Is there a written plan for continuous improvement of the educational program?

- What is the employers' role in that plan?
- Are the curricula of the educational program available for the employers? If yes, how often do they study them?
- In what way do the learning outcomes ensure the achievement of the educational program objectives?
- What are the strengths and weaknesses of the educational programs?
- What are the basic conditions that ensure the curriculum development?
- What changes should be done to improve the educational program?
- How important is your experience as an industry representative for this educational program?
- Has your company employed the graduates of this program lately?
- Do the graduates meet your requirements?
- результат вовлечения работодателей в процесс ее совершенствования? Если да, в чем заключались эти изменения?
- Существует ли в письменном виде план постоянного совершенствования образовательной программы?

Students – in group or individually

- Do you know what skills you will acquire by the end of the University course?
- How were you informed about the expected learning outcomes?
- Are you developing the required skills?
- Are the instructors really competent in the subjects they teach?
- Are they available and useful for you in any session time?
- Why did you choose this University and this program?
- Are the labs well equipped?
- Is the laboratory equipment in good condition?
- Does the program allow you to acquire sufficient practical experience?
- Are you going to continue your study after finishing the program? Where? When?
- Are you going to start working after the program? Where? When?
- What kind of job can you get as a graduate of this program? What will be the starting salary?
- What is your general concept of the program?
- Would you recommend this program to your friend?
- If you (or you parents) pay for your education, can you say that this program is worth paying?

Conclusion

The federal law "About the Education in the Russian federation" considers the process of educational program accreditation as the most effective factor of education quality improvement. It is vitally important to develop systems of continuous improvement of University programs by means of independent accreditation by domestic and international professional societies. Formal result of the external expertise can be regarded as a consumers' credit of trust to the program, but the main result is a real increase in the program quality.

REFERENCES

1. International Collaboration in the Sphere of Quality. Experience of Association of Engineering Education in Russia./ S.I. Gerasimov, Y.P. Pokholkov, A.I. Chuchalin, E.Y. Yatkina // Accreditation in Education.- 2012. - №8. – P. 32-33. (only in Russian)
2. Belyayev A. Educational Gap: Technological Education at the Turn of the XXI Century./ A. Belyayev, A. Livshits. – Tomsk: STT, 2003. – 503 p. (only in Russian)
3. Gerasimov S.I. Development of Professional-and-Public Accreditation Systems for Educational Programs in Russia and Abroad/ S.I. Gerasimov, S.O. Shaposhnikov// Quality. Innovation. Education. – 2012. - №12. – pp. 36-43. (only in Russian)
4. Accreditation Center of Association of Engineering Education in Russia [Electronic resource]: official site. – Moscow, 2003-2013. – URL:http://www.aeer.ru (reference date 08.07.2013).
5. Gerasimov S.I. Competence Model for Experts from Accreditation Center of Association of Engineering Education in Russia/ S.I. Gerasimov, E.Y. Yatkina // Engineering Education. – 2011. - №7. – P. 58-67.
6. European Network for Accreditation of Engineering Education [Electronic resource]: the offic. site. – Brussels, 2013. – URL: http://www.enaee.eu, free. – Tit. from the screen (usage date: 10.06.2013).
7. International Engineering Alliance [Electronic resource]: the offic. site. – Wellington, 2013. – URL: http://www.washingtonaccord.org, free. – Tit. from the screen (usage date: 08.06.2013).
8. Chuchalin A.I. Competences of Engineering Program Graduates: National and International Standards/ A.I. Chuchalin, S.I. Gerasimov// Higher Education in Russia. – 2012. - №10. – P. 3-14. (only in Russian).

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Criteria for Professional Accreditation of Engineering Programs of Secondary and Higher Vocational Education

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Key words: *professional public accreditation, engineering education, international standards.*

The new draft version of criteria for professional accreditation of engineering programs of secondary and higher vocational education is given in the paper. The criteria meet the requirements of new Federal Law "On Education in the Russian Federation" (№273-FZ) and correspond to the international standards such as EUR-ACE Framework Standards for Accreditation of Engineering Programmes and IEA Graduate Attributes and Professional Competences.

Development of professional public accreditation

In the last ten years Association for Engineering Education of Russia (AEER) has been successfully developing internationally integrated national system for professional accreditation of engineering programs of higher vocational education.

The evaluation criteria were developed in 2002 by AEER experts based on the best traditions of the national higher education and international experience of engineering education quality assurance. The following AEER structural elements as the Accreditation Centre and the Accreditation Board were founded. The AEER Accreditation Board consists of reputable repre-sentatives of academia, science, industry and professional organizations [1].

In 2003 AEER signed cooperation agreement with the Ministry of Education of Russian Fed-eration on the development of national system of professional accreditation of engineering and technology educational programs, in 2005 – cooperation agreement with the Federal Edu-cation and Science Supervision Service (Rosobrnadzor). In 2003 first 12 educational programs from 6 leading engineering universities of Russia were accredited following the AEER evaluation criteria corresponding international standards.

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Over the last decade AEER has continuously improved the accreditation criteria and procedure, widening cooperation with state authorities responsible for the education system gov-ernance, public and professional associations and alliances, industry representatives, foreign and international organizations which main activities are focused on the field of engineering education quality assurance. The number of accredited by AEER educational programs of Russian universities has also increased [1 -3].

During 2003-2013 period AEER concluded several agreements on independent external evaluation and professional accreditation of engineering educational programs with Chamber of Commerce and Industry of the Russian Federation (CCI), the Academy of Engineering Sciences (AES), Russian Union of Scientific and Engineering Associations (RUSEA), strengthened collaboration contacts with Russian Academy of Sciences (RAS), Russian Un-ion of Industrialists and Entrepreneurs, Agency of strategic initiatives and other organizations interested in development and improvement of engineering education in our country.

In 2004-2006 period AEER took an active part in running international project aimed at defi-nition of EUR-ACE Framework Standards for Accreditation of Engineering

Pro-grammes and development of European engineering programs accreditation system consistent with the whole Bologna Process. From 2006 AEER represents Russia in European Network for Accreditation of Engineering Education (ENAEE) along with public and professional or-ganizations from the United Kingdom (ECUK), France (CTI), Germany (ASIIN) and other countries, and is authorized to award a common European quality label (EUR-ACE Label) [4]. In 2008 AEER facilitated membership of RUSEA in Federation Europeenne d'Associations Nationales d'Ingenieurs (FEANI) [5].

In 2003-2007 period AEER enhanced cooperation with national agencies for engineer-ing programs accreditation – signatories of the Washington Accord such as ABET in USA, CEAB in Canada, JABEE in Japan and others. In 2007 AEER became provisional member and in 2012 became full member of the Washington Accord, the world's most authoritative organization in the field of evaluation and quality assurance of engineering education [6].

From 2010 AEER represents Russia in APEC Engineers Agreement, agreement on certification and registration of APEC Professional engineers, and in 2013 AEER was accept-ed as a Provisional Member to the International Professional Engineers Agreement (IPEA) – international organization that certifies and registers professional engineers globally.

Thus, over the last ten years, the Association for Engineering Education of Russia, to-gether with other stakeholders in the country established a national system of professional public accreditation in engineering education, which received international recognition, and started work on development national system for certification and registration of professional engineers. Currently, 220 educational programs of higher vocational education in the field of engineering and technology in universities of Russia and Kazakhstan were accredited by AEER. Most accredited programs were included in the international registers of ENAEE and FEANI [4,5]. More than 200 engineers from Russia and Kazakhstan took part in the pilot pro-ject for certification of engineering qualifications in accordance with international standards. About 80 engineers have successfully completed the certification process and are registered in the APEC Engineers Register [6].

New objectives and perspectives of professional accreditation

On September 1, 2013 the new Federal Law "On Education in the Russian Federation" (№ 273-FZ) will come into force. Following the new law (art. 96), "employers and their asso-ciations, as well as authorized by them organizations may carry out professional public-accreditation of educational programs delivered by the organization providing educational ac-tivities".

The new law defines professional public accreditation of vocational educational programs as "recognition of the quality and level of training of graduates who have graduated such an edu-cational program in a particular organization, carrying out educational activities that meet the requirements of professional standards, the requirements of the labor market for specialists, qualified workers and employees of the relevant profile". At the same time "data on the results of public or professional public accreditation that have an organization, carrying out ed-ucational activities, should be submitted to the accreditation body and are considered within the process of state accreditation".

Due to the fact that new Federal Law "On Education in the Russian Federation" will soon come into force AEER together with the Russian Ministry of Education, Rosobrnadzor, Rus-sian Union of Industrialists and Entrepreneurs and other stakeholders is involved in the devel-opment of new regulatory framework to carry out professional public accreditation regulating the interaction between state educational authorities, employers and authorized organizations. At the same time AEER updated accreditation criteria and procedure, taking into account the perspectives of engineering education development in Russia, the expansion of international recognition and credibility of training and qualifications of graduates of Russian educational institutions [3,7].

It was a new task for AEER to develop criteria for assessing the quality of applied bachelor programs and secondary vocational educational programs in the field of engineering and technology. Elaborated criteria correspond to the evaluation criteria for assessing the quality of academic bachelor programs, specialist and master degree programs, as well as the stand-ards of the International Engineering Alliance (IEA Graduate Attributes and Professional Competences) and the European Network for Accreditation of Engineering Education (EUR-ACE Framework Standards for Accreditation of Engineering Programmes) [4,6].

New professional accreditation criteria

New AEER accreditation criteria for degree engineering programs of secondary and higher vocational education are grouped as follows:

1. Program objectives and learning outcomes.
2. Program content.
3. Students and educational process.
4. Faculty.
5. Professional qualifications.
6. Program resources.
7. Graduates.

The criteria provide a common approach to professional public accreditation of educa-tional programs at various levels, which stimulates the coherence and continuity of educational programs for the creation of unified engineering education area that meets international practice [7].

The criteria are designed to evaluate quality of training of graduates from degree engineering programs of secondary and higher vocational education and validate that they are prepared for engineering practice, as well as to the applied, complex and innovative engineering activi-ties at the level meeting the requirements of professional standards, labor market and interna-tional requirements for the competence of engineering

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technicians, engineering technologists and professional engineers. The compliance with the criteria shall guarantee the quality of training and promote ongoing improvement of engineering programs.

Complex engineering activity is complex and multi-component. It includes planning, design, production and application of technical objects, systems and processes, covering a wide range of engineering, technical and other issues. Complex engineering problems associ-ated with the research, analysis and design of engineering products, systems and processes involve the use of basic knowledge of mathematics, natural sciences, engineering fundamen-tals and other sciences corresponding to area or specialty of training, as well as in-depth or specialized knowledge, including multi-disciplinary knowledge relevant to the profile or spe-cialization.

Training for complex engineering activity can be carried on the basis of academic bachelor or specialist degree programs of higher vocational education. The programs can be focused on experimental research, design, production and technological, organizational, managerial, and (or) other activities.

Innovative engineering activity could be considered as the next stage and development of complex engineering activity and is aimed at the development and creation of new techniques and technologies for new social and (or) economic impact, and therefore particularly competitive. Innovative engineering activity is multi-level and multi-disciplinary, it is based on in-depth fundamental and applied knowledge, analysis and synthesis of the characteristics of engineering products, systems and processes with the help of mathematical models of high level.

It is crucial for the innovative engineering activity the ability to design and conduct complex multivariate experiment, interpret data and draw conclusions in terms of ambiguity using in-depth knowledge and original methods to achieve the desired results. Another important element is an experience in design of engineering products, systems and processes including awareness of economic, environmental, social and other constraints.

Training for innovative engineering activity is based on master degree programs of higher vocational education. The profiles of educational programs could include research, design, production and technological, organizational, managerial, and (or) other activities.

Applied engineering activity is focused on the efficient use of engineering products, systems and processes, the development of advanced manufacturing technologies, new forms and methods of work organization. Applied engineering activity requires training in the field of active methods of technological development of production, balance of basic knowledge and practice-oriented competencies.

Training for applied engineering activity is based on applied bachelor degree programs of higher vocational education. Programs should provide practice-oriented training typical for secondary vocational education, and theoretical training typical for higher education programs at the bachelor's level. As a rule applied programs in engineering and technology are profiled on the production and technological activity.

Engineering technology practice is focused on technical assistance to engineering design, manufacturing, testing and operation of engineering products, systems and processes. The main objects of professional activity of engineering technicians is technical and technological equipment, and their main tasks are connected with its setup, maintenance, service and repair, etc.

Engineering technology practice is related to the installation and operation of equipment, tools and other components of engineering products, systems and processes. The solution of practical technical problems involves routine tasks, work with directories, measurements and other activities with the use of existing and well-known techniques and protocols. Training for engineering technology practice is based on training programs of secondary vocational education.

The following AEER criteria are based on program objectives and learning outcomes that outline general competencies (transferable skills) and professional (general and specific) competencies to be acquired by students upon completion of an engineering educational pro-gram.

The program can be accredited only if the achievement of learning outcomes by all the students is verified and the graduates are prepared for engineering practice in accordance with program objectives.

The program objectives are formulated by higher education institution (HEI) and should correspond with the institution mission. Learning outcomes are based on the program objectives and must meet the requirements of employers and other interested parties. The pro-gram objectives as well as learning outcomes of the program introduced for accreditation must be in full correspondence with the Federal State Educational Standard of the Russian Federation or HEI standard, and AEER criteria.

According to AEER accreditation procedure only licensed programs with state accred-itation are accepted for evaluation.

In order to be accredited a program must meet all of the criteria given below. The cri-teria establish different levels of compliance with the stipulated conditions:

- «must», «necessary» are used to specify the obligatory requirement for accrediting an engineering program;
- «recommended» means that the accomplishment of the requirement is recommended for accrediting an engineering program;
- «important consideration» means that the accomplishment of the requirement would be advantageous for accreditation but is not mandatory;
- «may» is used for offering alternative ways of meeting the criterion.

1. Program objectives and learning outcomes

Each engineering program must have clearly stated and documented objectives that are in full correspondence with the Federal State Educational Standard, HEI standard and the institution mission. Program objectives must be published and available for all interested parties as well as shared by each faculty member participating in program delivery.

Learning outcomes the educational program must be consistent with its objectives, to be documented and clearly expressed in terms of the level of graduates' competence that meet the requirements of AEER Criterion 5, the Federal State Educational Standard, HEI standard relevant to the specialization or profile of training.

There must be an effective system for achieving and adjusting objectives and learning outcomes. The data obtained by means of this system should be used to improve the curricu-lum and the training process.

Particular attention should be paid to the fact that program objectives and learning outcomes must meet the requirements of professional standards, the needs of the labor market and the needs of potential employers. Therefore, it is recommended to involve industry repre-sentatives in the process of developing and improving educational programs.

2. Program content

In accordance with the requirements of the Federal State Educational Standards con-tent of educational programs is evaluated in credits – European Credit Transfer System (ECTS), recommended in the framework of the Bologna process. The bachelor program must be of at least 240 ECTS credits, specialist program – at least 300 ECTS credits, master pro-gram - at least 120 ECTS credits.

The program and syllabus for each course must include disciplines and interdisciplinary modules consistent with the program objectives. They should ensure the achievement of general (transferable skills) and professional competences by all the graduates, as well as practical experience in specific field of activity relevant to the awarded qualification.

The curriculum must include scientific, mathematical, humanitarian, socio-economic and professional disciplines, as well as interdisciplinary modules and practice (R&D). The amount of the natural sciences and mathematical disciplines in a practice-oriented training within applied bachelor programs is recommended to be of at least 30 ECTS credits, academic bachelor and specialist programs - must be of at least 60 ECTS credits. In master programs recommended amount of in-depth scientific and mathematical disciplines –12-15 ECTS credits. The recommended amount of humanitarian and socio-economic disciplines in aca-demic bachelor and specialist – 20-30 ECTS credits.

Professional disciplines and interdisciplinary modules must ensure that graduates are prepared to practical engineering activity in accordance with the objectives of the educational program. The volume of professional disciplines and interdisciplinary modules must be of at least 50% of the content of training programs for engineering technician, as well as of at least 120 ECTS credits – for applied bachelor, 110 ECTS credits – for academic bachelor, 150 ECTS credits – for specialist and 30 ECTS credits – for master degree programs.

Duration of practical training for technicians must be at least 25 weeks, and for applied bachelors – not less than 18 weeks. The recommended duration of practical training for academic bachelors – at least 12 weeks, and for specialists – 16 weeks. In the master degree programs recommended volume of total practices and research – at least 50 ECTS credits.

Educational programs of higher education in the field of engineering and technology should contain course projects providing planning, design and application of engineering products, systems and processes. An important factor is execution of real projects demanded by the customer.

The program must culminate with the final qualification work focused on practical ac-tivities (training program for technicians and applied bachelors) or with the elements of re-search and development (academic bachelor, specialist and master programs).

3. Students and educational process

Students admitted for the program of secondary vocational education, bachelor or specialist degree programs must have a complete secondary education. Students admitted for the master program must complete a first cycle program (at least bachelor degree) and must demonstrate a necessary level of knowledge in natural sciences and mathematics.

Educational process must ensure the achievement of learning outcomes by all the students. The HEI running the program must have a system ensuring on-going evaluation of the ac-complishment of the curricular tasks as well as a feedback mechanism for continuous im-provement of the program.

When evaluating the program more attention should be paid to implementation of practice-oriented technologies, organization of independent work of students, using open edu-cational resources available at HEI Internet-site.

An important element of educational process is the presence of academic adaptation system for students, student-centered educational environment and system of students' aca-demic mobility.

4. Faculty

Teaching staff in secondary education institutions and academic staff in HEIs must be repre-sented by experts so as to cover all of the curricular areas of the program. Teaching staff must have a sufficient level of qualification and systematically improve qualification by professional development, internships, additional training to master their teaching skills.

The teaching staff industrial experience in the relevant field and membership in professional associations, awards, grants and fellowships are of important consideration in program evalu-ation. Faculty members must be actively involved in technical projects (secondary vocational education programs), engineering, research, design, production projects(higher educational programs) that must be evidenced by research and methodological reports, participation in scientific conferences, publications. The faculty must be involved in the improvement of both the whole program and each discipline.

Each teaching staff member must comprehend and prove the relation and links of his disci-pline to other curricular components, and understand the role of his discipline in educational process. Involvement of experts from industry and research institutions in the training process is of important consideration in program evaluation.

The number of teaching staff with doctoral degrees (PhD and DSc) must be not less than 50% of the faculty participating in applied bachelor program delivery, not less than 60% of the faculty participating in academic bachelor and specialist programs delivery, and not less than 80% of the faculty participating in master program delivery. Attracting experts with doctoral degrees in the training process is considered as the advantage for the evaluated pro-gram. The faculty turnover must not exceed 40% during the accreditation period.

5. Professional qualifications

Students must have been preparing for engineering practice through the whole period of study. The research and design experience must be based on the knowledge and skills ac-quired within the interdisciplinary modules of educational program, educational practical and on-the-job internships, conducting research, preparing course papers, final qualification papers and projects. Student's portfolio with the results of studying and research activity, par-ticipation in different kind of academic competitions, grants and other events.

The program must ensure the achievement of the learning outcomes required for engineering activity by all the graduates. Below there is a list of requirements to learning outcomes (competences) of graduates from engineering technician program (T), applied bachelor program (Ap. B), academic bachelor program (Ac. B), specialist program (S) and master program (M).

1. Professional profile (competences)

1.1. Knowledge and understanding

T. Apply knowledge of mathematics, natural science, humanities and socioeconomic sciences, specific engineering fundamentals for the solution of practical engineering problems relevant to area of specialization.

Ap.B. Apply basic knowledge of mathematics, natural science, humanities and socioeconomic sciences, specific engineering fundamentals for the solution of applied engineering problems relevant to training profile.

Ac.B. Apply basic and in-depth knowledge of mathematics, natural science, humanities and socioeconomic sciences, engineering fundamentals in multidisciplinary context for the solution of complex engineering problems relevant to branch of engineering training.

S. Apply basic and specific knowledge of mathematics, natural science, humanities and socioeconomic sciences, engineering fundamentals in multidisciplinary context for the solution of complex engineering problems relevant to area of specialization.

M. apply in-depth knowledge of mathematics, natural science, humanities and socioeconomic sciences, engineering fundamentals in multidisciplinary context for the solution of innovative engineering problems relevant to branch of engineering training.

1.2. Engineering Analysis

T. Identify and solve practical engineering problems relevant to area of specialization using established known methods.

Ap.B. Formulate and solve applied engineering problems relevant to training profile using basic and specific knowledge, modern relevant analytic methods.

Ac.B. Formulate and solve complex problems of engineering analysis relevant to branch of engineering training using basic and specific knowledge, modern relevant analytic and modeling methods.

S. Formulate and solve complex problems of engineering analysis relevant to area of specialization using basic and specific knowledge, modern relevant analytic and modeling methods.

M. Formulate and solve innovative problems of engineering analysis relevant to branch of engineering training using in-depth engineering fundamentals, modern relevant analytic and complex modeling methods.

1.3. Engineering Design

T. Solve practical engineering problems and contribution to design of engineering products, systems and processes relevant to area of specialization including an awareness of societal, health and safety, environmental and other considerations.

Ap.B. solve applied engineering problems and participation in design of engineering products, systems and processes relevant to training profile including an awareness of societal, health and safety, environmental and other considerations.

Ac.B. Execute complex engineering projects of engineering products, systems and processes relevant to branch of engineering training including an awareness of societal, health and safety, environmental and other considerations.

S. Execute complex engineering projects of engineering products, systems and processes relevant to area of specialization including an awareness of societal, health and safety, environmental and other considerations.

M. Execute innovative engineering projects of engineering products, systems and processes relevant to branch of engineering training including an awareness of hard societal, health and safety, environmental and other considerations.

1.4. Investigations

T. Conduct searchers of information to solve practical technical problems relevant to area of specialization, locate and search relevant codes and catalogues, conduct standard tests and measurements.

Ap.B. Conduct investigations to solve applied engineering problems relevant to train-ing profile, conduct searches of literature use data bases, design and conduct experiments.

Ac.B. Conduct investigations to solve complex engineering problems relevant to branch of engineering training, design and conduct experiments, interpret the data applying basic and in-depth knowledge.

S. Conduct investigations to solve complex engineering problems relevant to area of specialization, design and conduct experiments, interpret the data applying basic and specific knowledge.

M. Conduct investigations to solve innovative engineering problems relevant to branch of engineering training, design and conduct complex experiment, interpret the data and draw conclusions applying in-depth knowledge and modern methods.

1.5. Engineering Practice

T. Apply techniques, resources, and modern engineering and IT tools including prediction and modelling to solve practical technical problems relevant to area of specialization , with an understanding of the limitations.

Ap.B. Select and apply techniques, resources, and modern engineering and IT tools, including prediction and modelling, to solve applied engineering problems relevant to training profile, with an understanding of the limitations.

Ac.B. Develop, select and apply techniques, resources, and modern engineering and IT tools, including prediction and modelling, to solve complex engineering problems relevant to branch of engineering training, with an understanding of the limitations.

S. Develop, select and apply techniques, resources, and modern engineering and IT tools, including prediction and modelling, to solve complex engineering problems relevant to area of specialization, with an understanding of the limitations.

M. Develop and apply techniques, resources, and modern engineering and IT tools, including prediction and modelling, to solve innovative engineering problems relevant to branch of engineering training, with an understanding of strict limitations.

1.6. Specialization and focus on labor market

T. Demonstrate competencies associated with special features of tasks, objects and types of engineering technology practice relevant to area of specialization at enterprises and organizations of potential employers.

Ap.B. Demonstrate competencies associated with special features of tasks, objects and types of applied engineering activity relevant to training profile at enterprises and organizations of potential employers.

Ac.B. Demonstrate competencies associated with special features of tasks, objects and types of complex engineering activity profile and branch of engineering training at enterprises and organizations of potential employers.

S. Demonstrate competencies associated with special features of tasks, objects and types of complex engineering activity relevant to area of specialization at enterprises and organizations of potential employers.

M. Demonstrate competencies associated with special features of tasks, objects and types of innovative engineering activity profile and branch of engineering training at enterprises and organizations of potential employers.

2.General competencies (Transferable skills)

2.1. Management

T. Apply knowledge of engineering technology practice management principles relevant to area of specialization.

Ap.B. Apply basic knowledge of applied engineering activity management principles relevant to training profile.

Ac.B. Apply basic and in-depth knowledge of complex engineering activity management principles relevant to branch of engineering training.

S. Apply basic and specific knowledge of complex engineering activity management principles relevant to area of specialization.

M. Apply knowledge in project and financial management for innovative engineering activity relevant to training profile.

2.2. Communication

T. Communicate effectively with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, give and receive clear instructions, make effective presentation on results of engineering technology practice relevant to area of specialization.

Ap.B. Communicate effectively with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, give and receive clear instructions, make effective presentation on results of applied engineering activity relevant to training profile.

Ac.B. Communicate effectively using foreign language with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentation on results of complex engineering activity relevant to branch of engineering training.

S. Communicate effectively using foreign language with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentation on results of complex engineering activity relevant to area of specialization.

M. Communicate effectively using foreign language with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentation on results of innovative engineering activity relevant to branch of engineering training.

2.3. Individual and Team Work

T. Function effectively as an individual, and as a member of a team to solve practical technical problems relevant to area of specialization.

Ap.B. Function effectively as an individual, and as a member or leader of a team to solve applied engineering problems relevant to training profile.

Ac.B. Function effectively as an individual, and as a member or leader of a multidisciplinary team sharing responsibility and delegating authority to solve complex engineering problems relevant to branch of engineering training.

S. Function effectively as an individual, and as a member or leader of a multidisciplinary team sharing responsibility and delegating authority to solve complex engineering problems relevant to area of specialization.

M. Function effectively as an individual, and as a member or leader of a multidisciplinary team sharing responsibility and delegating authority to solve innovative engineering problems relevant to branch of engineering training.

2.4. Professional Ethics

T. Personal responsibility and commitment to professional ethics engineering technology practice.

Ap.B. Personal responsibility and commitment to professional ethics in applied engineering activity.

Ac.B. Personal responsibility and commitment to professional ethics in complex engineering activity.

S. Personal responsibility and commitment to professional ethics in complex engineering activity.

M. Personal responsibility and commitment to professional ethics in innovative engineering activity.

2.5. Social Responsability

T. Demonstrate understanding of the societal, health, safety issues and the consequent responsibilities for engineering technology practice relevant to area of specialization and con-tribute to ensure sustainable development.

Ap.B. Demonstrate understanding of the societal, health, safety, cultural and legal issues and the consequent responsibilities for applied engineering activity relevant to training profile and take active part to ensure sustainable development.

Ac.B. Demonstrate understanding of the societal, health, safety, cultural and legal issues and the consequent responsibilities for complex engineering activity relevant to branch of engineering training and ensure sustainable development.

S. Demonstrate understanding of the societal, health, safety, cultural and legal issues and the consequent responsibilities for complex engineering activity relevant to area of specialization and ensure sustainable development.

M. Demonstrate understanding of the societal, health, safety, cultural and legal issues and the consequent responsibilities for innovative engineering activity relevant to branch of engineering training and ensure sustainable development.

2.6. Lifelong learning

T, Ap.B., Ac.B., S, M. Recognize the need for, and have the ability to engage in independent and lifelong learning

Higher educational institution develops and supplements presented above requirements to professional and general competencies of graduates of secondary and higher vocational education programs in the field of engineering and technology as well as planned learning outcomes relevant to area of specialization or training profile and in order to meet the requirements of professional standards as well as the labor market and employers requirements (demands of strategic partners).

The department/institution must have an assessment process of learning outcomes for both the whole program and each discipline with documented results. The results must be used for further program and educational process improvement.

3. Program resources

The educational program facilities, information and financial resources must be in full correspondence with the license requirements and meet the program objectives.

The institution resources must be sufficient to provide all students opportunity to achieve program learning outcomes. Particular attention is paid to the use of modern educational technologies and information resources, including the organization of an independent work and research activities of students.

One of the key elements in delivering higher vocational programs is the availability of Internet-access to the world's information resources for teachers and students, including na-tional and foreign databases of the latest scientific publications.
HEI must have sufficient re-sources (classrooms, associated equipment and tools) to provide research, design, engineering and technology activities of students to facilitate acquisition of practical experience in devel-opment of engineering products and systems, including teamwork environment.

The institution financial policy and management must aim to improve the quality of the program and provide continuous development of competencies and skills of teaching and support staff.

Organization and management of the educational unit responsible for the program must be effective and contribute to the implementation of educational programs. An important factor is the presence in the educational organization of modern quality management system.

The institution/department management must be efficient to guarantee the accom-plishment of program outcomes and promote improvement of the program.

Existence of quality management system of the institution is an important considera-tion in program evaluation.

4. Graduates

To ensure relevance and competitiveness of the educational program and its continuous improvement HEI must have monitoring system to study the labor market needs, as well as to support graduates and get feedback from them, especially during the first 3-5 years upon graduation from the program.

Conclusions

The given above new accreditation criteria for programs of secondary vocational edu-cation, applied and academic bachelor programs, specialist and master programs correspond with the international standards IEA Graduate Attributes and Professional Competences in terms of the requirements applied under Dublin Accord, Sydney Accord and Washington Ac-cord, correspondingly.

Graduates of accredited by AEER programs of secondary vocational education will be able to apply for the procedure of certification and registration in the International Engineer-ing Technicians Register. Graduates of accredited by AEER applied bachelor programs will be able to apply for the procedure of certification and registration in the International Engi-neering Technologists Register, and graduates of the accredited academic bachelor and spe-cialist programs will be able to apply for certification and registration in the APEC Engineer Register and International Professional Engineers Register.

Criteria for professional accreditation of bachelor, specialist and master degree pro-grams also correspond with EUR-ACE Framework Standards for Accreditation of Engineering Programmes in terms of requirements to the programs of First and Second Cycle in framework of Bologna Process.

Graduates of accredited by AEER programs of higher vocational education will be able to apply for certification and registration in FEANI Register and have an advantage in obtaining the title of "European Engineer" (EurIng) and European ENGCard.

The criteria presented in this paper are going to be used for professional accreditation of educational programs (secondary and higher vocational education) developed on the basis of the Federal State Educational Standard of the Russian Federation. Higher education institutions are recommended to use these criteria when designing new and updating existing educational programs to meet the requirements of the amended version of the Federal State Educational Standard, adapted to the Federal Law "On Education in the Russian Federation" dated December 29, 2012.

REFERENCES

1. Accreditation Center Association for Engineering Education of Russia [Electronic resource]: the official AEER web site. – URL: http://www.ac-raee.ru
2. Yu.P. Pokholkov, A.I. Chuchalin, O.V. Boev Quality assurance of engineering training: accreditation of educational programs and specialists' certification // Voprosy obrazovanija (Journal of Educational Studies), 2004, № 4, p. 125-142.
3. A.I. Chuchalin, S.I. Gerasimov Competencies of engineering programs graduates: national and international standards // Vysshee obrazovanije v Rossii (Higher Education in Russia), 2012, № 10, p. 3 – 14.
4. European Network for Accreditation of Engineering Education, ENAEE [Electronic resource]: the official ENAEE web site - URL: http://www.enaee.eu
5. European Federation of National Engineering Associations, FEANI [Electronic re-source]: the official FEANI web site - URL: http://www.feani.eu
6. International Engineering Alliance [Electronic resource]: the official IEA web site - URL: http://www.ieagreements.org
7. A.I. Chuchalin Implementing International Engineering Alliance standards for de-sign and evaluation of educational programs // Vysshee obrazovanije v Rossii (Higher Educa-tion in Russia), 2013, № 4, p. 12 – 26

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International Engineering Alliance Congress

(June, 2013 Seoul, Republic of Korea)

National Research Tomsk Polytechnic University
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Key words: *certification, accreditation of professional engineers, Russian Association of Engineering Education (AEER), IEA, IPEA.*

Report of Association of Engineering Education in Russia on participation in Interna-tional Engineering Alliance Congress, 2013. The major achievement of the Association of Engineering Education in (AEER) was its initiation as a provisional member of the Interna-tional Agreement in professional engineer certification (IPEA). Besides, AEER discussed the formulation of accreditation criteria for programs of secondary vocational education and en-gineering Bachelor degree.

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Regular International Engineering Alliance Congress (International Engineering Alli-ance, IEA) was held in Seoul (Republic of Korea) from June 16-21, 2013, where a delegation of Russian Association of Engineering Education (AEER) participated.

International Engineering Alliance, IEA embraces public-professional organizations involved in the problems of engineering education quality and promotion of specialist qualification in engineering and technology within world leading countries [1]. These organizations in IEA include representatives of real economy employers, members of engineering communities, scientists and university instructors. In this case, such public-professional organizations represent the interests of different parties in a balanced way and define objectively development tendencies of technical education and engineering profession including those factors that influence the scientific and technological progress.

The IEA structure includes those organizations that train professional engineers and technologists in accordance with competency requirements (International Professional Engineers Agreement / IPEA, APEC Engineers Agreement, International Engineering Technologists Agreement / ETA), and organizations elaborating relevant standards of engineering education in universities and colleges (Washington Accord, Sydney Accord, Dublin Accord). Based on approved requirements for specialist competencies, indicated organizations develop and apply the criteria and procedures for international certification of Professional Engineers, Engineering Technicians and Engineering Technologists, as well as, accreditation of specialist programs in universities and colleges.

Consistency of international standards of different specialist training levels in engineering and technology and competency requirements for professional engineers, technicians and technologists is a significant factor in improving not only the engineering education, engineering, production technology development but also, in the long run, the economy of IEA country-participants (USA, Great Britain, Canada, Japan and others).

AEER, member of APEC Engineers Agreement (from 2010), full member of Washington Accord (from 2012) and provisional member of IPEA (from 2013), is the representative of Russia within the International Engineering Alliance. Russian Association of Engineering Education, developing the national public-professional system of university education program accreditation in engineering and technology for the last 10 years and modeling the potential background for the certification and licensure system of professional engineers, coordinates and finalizes all criteria and procedures with the international IEA organization partners [2].

Within the framework of the IEA Congress, plenary sessions and workshops embraced the issues associated with management planning of the International Engineering Alliance it-self, changes in its structure and IEA Charter and discussions involving different important problems in engineering education and engineering profession. In particular, the updating of one of the basic documents - IEA Graduate Attributes and Professional Competencies. This document defines the requirements for university and college graduate learning outcomes of engineering programs, accredited within the framework of Washington Accord, Sydney Accord and Dublin Accord, as well as, those competency requirements for professional engineers and technologists striving for professional recognition through certification and licensure programs in accordance to international standards IPEA, APEC Engineers Agreement and IETA, respectively.

Executive sessions of IEA organization partners were also held. Reports of different organization members describing their 2-year work after the previous Congress (IEA Congress in Taipei, 2011) were heard and discussed, as well as, other numerous issues including the election of new organization members.

At the executive session of International Accord in professional engineer certification IPEA (before 2013-Engineers Mobility Forum), Russian Association of Engineering Education was granted the status of a provisional member. The partners of this Accord, formulating the international standards of professional engineer competencies, are NCEES (USA), Engineers Canada (Canada), ECUK (Great Britain), IPEJ (Japan), KPEA (South Korea) and professional engineer organizations from 15 other countries. It was IPEJ (Japan) and KPEA (South Korea) that nominated AEER as a provisional member in IEA. The accession of AEER to the IPEA significantly broadens the international recognition of Russian engineer-specialist qualification and enhanced their competencies throughout the world.

IPEA standards, in many aspects, are analogous to the requirements stated in APEC Engineers Agreement, which, in its turn, are applicable within the framework of Asia-Pacific Economic Cooperation (APEC). Russian Association of Engineering Education is a member of the APEC Engineers Agreement from 2010 and in cooperation with Russian Alliance of Scientific and Engineering Associations is engaged in the implementation of national certification and licensure system of professional engineers, supported by Ministry of Education and Science RF, Federal Education and Science Supervision Agency, RF Chamber of Commerce and Industry, Association of Technical Universities (ATU), State Duma RF, Strategic Initiative Agency (SIA) and other organizations [3]. In 2010 the Russian Monitoring Committee of

Professional Engineers was established to provide and award the rank "APEC Engineer" through registration where appropriate (both Russian and international licensing). AEER experts have developed the normative framework applicable in evaluating the competencies of Russian engineers who work in different professional areas.

The first Certification Center supported by Russian Alliance of Scientific and Engineering Associations (RASEA) and AEER was established in 2010 within National Research Tomsk Polytechnic University (TPU). In 2012-2013 more than 200 applicant requests in pursuing registration as "APEC Engineer", including 9 enterprise-organization applicants from Russia and Kazakhstan were submitted to the Center of International Certification of Engineering Education and Engineering Profession, TPU.

A candidate interested in pursuing registration and certification is encouraged to check the criteria maintained by APEC Engineers Agreement and IPEA and should:

- be a university graduate of accredited engineering program;
- have the right to conduct individual engineering practice;
- have at least 7- year work experience after graduation;
- have at least 2-year executive experience in the implementation of an important engineering project;
- demonstrate a continuous improvement of one's professional qualification;
- show commitment to the understanding of the professional ethic Code.

More than 80 engineers have successfully passed and have been registered in the international register "APEC Engineer" (http://www.ieagreements.org). The distribution of certified engineers in different professional areas is shown in Fig. 1.

In 2012 Expert Council of Strategic Initiative Agency (SIA) approved the following project "Network of International Engineering Education Accreditation and Engineering Qualification Certification Center" (ID 2012-1363). This Council initiated the Project development of certification centers in the Federal Districts of the Russian Federation within the regional structures of Russian employer organizations - Union of Industrialists and Entrepreneurs (RUIE) and Chamber of Commerce and Industry (CCI).

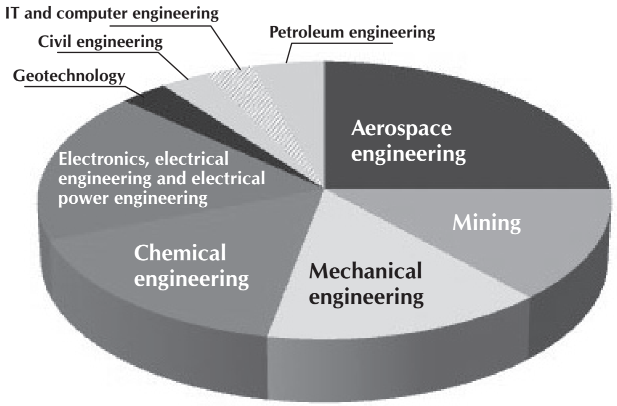
To monitor the national certification and registration system of professional engineers, in April, 2013 the unified Russian Monitoring Committee of Professional Engineers, being integrated into the international structures FEANI, IPEA and APEC Engineers Agreement, was established. The Committee includes representatives of organizations (RASEA, AEER, CCI, RUIE, ATU, National Fund of Personnel Training (NFPT), SIA), governmental organizations (Ministry of Education and Science RF, Federal Education and Science Supervision Agency, Federal Council RF), enterprises and businesses (Rosatom, Rosnano, Pharm-Cluster, , UAC-United Aircraft Consortium and other companies).

To provide operative functioning of regional certification centers throughout the entities of the Russian Federation, the Russian Monitoring Committee of Professional Engineers developed and approved relevant information-methodological resources.

The following supporting documents include [4]:

- Provision of Russian Monitoring Committee of Professional Engineers.
- Standard of Professional Engineers.
- Code of Professional Engineers.
- List of universal, professional and focused competencies for individual professional engineering practice in this or that area of specialization.
- Provision of evaluation procedure for engineering practice results in accordance with Standard of Professional Engineers.

Fig. 1. Distribution of Certified Engineers in Different Professional Areas



- Provision of examination procedure for evaluation of competencies of individual professional engineering practice in this or that area of specialization within the framework of Standard of Professional Engineers.
- Provision of suspension and cancellation of registration in the Russian register of professional engineers.
- Provision of continuous qualification improvement and enhancement of professional engineering competencies.
- Provision of Certification Council.
- Provision of Appeals Commission.
- Provision of Training Institute of Professional Engineers.
- Standard regulations for Certification Center.
- Standard instructions for employees of Certification Center.
- List of specialization areas of individual professional engineering practice for certification and registration of professional engineers in Russia.

The development of the national certification and registration system of professional engineers, being integrated into the international structures FEANI, IPEA and APEC Engineers Agreement, implement the following targets:

- Retaining "engineer" title and strengthening his/her recognition in conditions of higher education level-system (Bachelor-Master).
- Improving domestic engineering education in accordance with world standards, promoting continuous qualification improvement system for professional engineers.
- Training specialists in engineering and technology with international qualification recognition.
- Enhancing the global competitiveness of national economy through the development of competencies of engineer corps.

Russian Association of Engineering Education submitted a report to the Washington Accord session. This report included the details of its activities in the development of the national public-professional accreditation system for university education programs in engineering and technology, as well as, Gap Analysis in accordance to the accreditation requirements-Criterion 5 of AEER "Professional Training" and requirements of International Engineering Alliance "Graduate Attributes and Professional Competencies".

At the Dublin Accord session AEER representatives discussed the formulation of public-professional accreditation criteria for programs of secondary vocational education in technical specialties relevant to IEA Graduate Attributes and Professional Competencies, as well as, Dublin Accord requirements. AEER achieved a collaboration agreement with ECUK (Great Britain) and Engineers Ireland (Ireland) on the development of accreditation system for programs of secondary vocational education in Russian colleges and technical schools and request preparation of AEER accession to Dublin Accord in 2014.

Russian Association of Engineering Education has also developed quality assessment criteria for bachelor engineering degree programs relevant to IEA Graduate Attributes and Professional Competencies, as well as, Sydney Accord. In prospect, AEER plans to implement public-professional accreditation of engineering bachelor degree programs in Russian universities and accession to Sydney Accord.

Planned activities of AEER in the sphere of publicprofessional accreditation of secondary vocational education and engineering bachelor degree programs in accordance to Dublin Accord and Sydney Accord, respectively, would provide the conditions to develop the national certification system of technicians and technologists in accordance to international standards Engineering Technicians и Engineering Technologists.

Interested parties in the establishment and development of national certification system and registration are graduates of technical universities and colleges (improve their competencies, qualification, competitiveness and mobility on the labor market), enterprises (enhance their human resources, expand production potential, advance competitiveness in the country and abroad), technical universities and colleges (improve graduate training quality in future professional engineering practice and enhance recognition of the education institution itself) and the country (deepen the international economic integration, increase the global competitiveness under conditions of accession to WTO).

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REFERENCES

1. International Engineering Alliance [Electronic resource]: [offic. site]. – [S. l., 2013]. – URL: http://www.ieagreements.org, free. – Tit. from the screen (usage date: 01.08.2013).
2. Chuchalin A.I. Application of International Engineering Alliance Standards in Developing and Assessing Educational Programs provided by Higher Professional Institutions and Vocational Professional Establishments // Higher Education in Russia. – 2013. – № 4. – P. 12–26.
3. Chubik P.S. Designing National Engineering Certification System Based on International Standards / P. S. Chubik, A. I. Chuchalin, A. V. Zamyatin // Engineering Education. – 2012. – № 10. – P. 92–98.
4. Russian Monitoring Committee of Professional Engineers / P.S. Chubik, A.I. Chuchalin, S.A. Zybin. [et al.] // Regulative Documents of Russian Engineering Qualification Registration and Certification. – Tomsk: TPU, 2013. – 54 p.

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Public-Professional Accreditation – Effective Tool in Improving Education Programs. Experience of Tomsk Polytechnic University

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Key words: *public-professional accreditation, educational programs, accreditation criteria, experts, expert commission.*

The article presents the analysis of AEER expert committee reports which describe public-professional accreditation of educational programs in Tomsk Polytechnic University from 2003 to 2012. The special focus is made on the changes initiated by University to meet AEER accreditation criteria. Based only on the data presented in the expert committee reports, the opinion about university policy in development and implementation of educational programs, as well as systemic error probability and obvious university benefits has been issued. The main purpose is to draw attention of higher education institutions to the importance of being accredited by public-professional organizations and the necessity to conduct continuous monitoring of expert committee reports as a valid indicator of university performance. Our experience and recommendations could be of great importance for those who are planning to undergo public-professional accreditation.

The achievements of Tomsk Polytechnic University (TPU) clearly demonstrate its determination to become one of the world's top universities.

In 2006, TPU was awarded the RF Government Quality Management Prize. In 2007 the university became the winner of innovative educational programs competition in the framework of Priority National Project "Education". In 2009, it received the status of National Research University. TPU is currently among the candidates for the status of Leading Research University.

RF Government Prizes, victories in various competitions, status of National Research University – all this is the result of consistent work in quality assurance and enhancement in all areas of University activities.

Continuous quality enhancement of educational programs is of special attention in TPU. The positive effect of independent assessment is the subject of wide speculation. A widely shared view that public-professional accreditation is one of the most effective tools in improving engineering educational programs is beyond question.

TPU has a vast experience in accrediting educational programs (more than 50) in national and foreign accreditation agencies. The quality of educational programs offered by TPU were accredited by such organizations as Independent Accreditation Center for Engineering and Technology, Russia (IACET), Canadian Engineering Accreditation Board, Canada (CEAB), Accreditation Board for Engineering and Technology, USA (ABET), Association for Engineering Education of Russia (AEER).

The first experience in the accreditation of educational programs in engineering and technology in Tomsk Polytechnic University dated 1996, when five educational programs for graduate-specialists were accredited. This accreditation was conducted by the Independent Accreditation Center (IAC), which was based on the self-developed criteria.

The cooperation of TPU with AEER, especially in educational program quality assurance, was proved to be the most productive and longstanding.

During the past 10 years basic and repeated public-professional accreditation procedures of 43 education programs in engineering and technology were initiated in AEER. More than 20 AEER expert committees visited TPU including participating countries of European Network for Accreditation of Engineering Education and Washington Accord.

On the basis of the audit results, expert committee prepared evaluation reports including collegial and individual recommendations, identification of strengths and weaknesses of each educational program. These reports were analyzed by University authority; corresponding corrective action plans were developed. The gained experience has become of great importance in further professional-public accreditation of educational programs.

TPU has acquired enormous experience which can be of great importance for those universities which are planning to submit educational programs in the field of engineering and technology for public-professional accreditation. The conducted research has revealed that accreditation results of educational programs can be used not only as an indicator of teaching quality, but also as one of the indicators of university efficiency, as a whole.

The comparative review of expert committee reports which describe the public-professional accreditation of educational programs in Tomsk Polytechnic University from 2003 to 2012 is presented below. For the sake of convenience, the information is structured in accordance with criteria – in this case the changes in various university activities become more obvious.

In 2003, TPU was one of the six universities which took part in AEER "pilot" accreditation of educational programs in the field of engineering and technology [1]. The TPU pilot project included accreditation of Bachelor Degree Program 552800 "IT and Computer Science" and 551300 "Electrical Engineering, Electromechanics, Electrotechnics".

The educational program (curriculum) was evaluated in accordance with the following 8 criteria:

1. Program curriculum
2. Quality
3. Faculty
4. Professional component
5. Facilities
6. Information infrastructure
7. Financial support
8. Graduates

The educational programs submitted for accreditation were highly appraised in terms of "Curriculum Content". The strengths of these programs involved such facts as efficient mechanism in attaining the program educational objectives, solid student outcomes in Sciences and Mathematics, core professional courses and profile professional courses, advanced courses in English and economics.

According to committee decision, the weakness of these programs included insufficient understanding of ethic, socio-political and ecological aspects and the recommendation was to provide and consider these issues within specific courses and in graduate qualification papers. The Commission also highlighted the fact that RF enterprises are not fully interested in Bachelor degree graduates and obviously prefer graduate-specialists.

The EUR-ACE Project aimed at setting up a coordinated European system for engineering education accreditation within the Bologna process was being implemented in 2004-2006 [2]. Russia was represented by AEER in this project. EUR-ACE Framework Standards for Accreditation of Engineering Programs were developed as a part of the project [3].

TPU also took part in pilot accreditation projects in accordance with AEER criteria which were revised based on international standards. In 2007, AEER gained the right to assign the European "quality label"-EUR-ACE label-subsequent to the accreditation results of engineering educational programs. Since that time, all educational programs offered by TPU have been audited for compliance with international standards.

The list of AEER criteria [4]:

The educational program (curriculum) was assessed in accordance to the following 9 criteria:

1. Program educational objectives
2. Program content
3. Students and study process
4. Faculty
5. Professional qualification
6. Facilities
7. Information infrastructures
8. Finance and management
9. Graduates

Listed below are the most frequent recommendations of expert commissions.

Criterion 1. Program educational objectives

Criterion requirements: The Program objectives should be consistent with the state education standards and meet the needs of constituencies. In this case, they should be precisely formulated and documented.

As a rule, this criterion is evaluated positively. However, there were cases when it was recommended to upgrade the mechanism for achieving and amending the objectives, updating the educational program (curriculum) itself through continuous monitoring of the needs of potential constituencies.

Criterion 2. Program curriculum

Criterion requirements: Program curriculum should include not less than ECTS 300 credits for specialist training programs, not less than ECTS 240 credits for Bachelor degree programs and not less than ECTS 120 credits for Master degree programs. Program curriculum should be consistent with the objectives and prepare students to attain learning outcomes.

It is one of the most illustrative criteria. In 2004-2010 the requirements of both the Ministry of Education and Science and AEER significantly differ. This is precisely why both commissions highlighted such facts as specified irrelevance of the indexes and curriculum hours of some courses to those hours stated in State Education Standard of Higher Professional Education, RF, modification of course-hour ratios. As all above-mentioned factors are relevant to the University standard itself, particular recommendations to exclude the existing situation were not stated.

In some aspects, the criterion requirements to ensure competencies in economic, ethic, socio-political, ecological issues, as well as, in labor safety and sustainable development are otherwise. Practically all commission members recommended making provision for above-mentioned factors in graduate qualification and term papers. However, there is no significant modification of this requirement implementation in the University.

At the same time, there is an obvious increase in the number of requirements of this criterion, which in its turn, made it possible to underline the strengths of such accredited program curricula, i.e. availability of individual student tasks, study manuals assigned by Education and Methodic Association (EMA) in classical University education (MSU), application of sophisticated teaching technologies and student participation in industrial activities from the second University year.

Criterion 3. Students and study process

Criterion requirements: The academic process should ensure that each student attains those learning outcomes consistent with program education objectives. Students should have internship opportunities in different enterprises and participation possibilities in academic mobility programs.

Traditionally, there are practically no comments and recommendations in respect to this criterion. Well-established and concise procedure of testing, additional educational programs and "compensation" courses for students with inadequate basic knowledge-level have been positively evaluated. The strengths of these education programs are (1) obligatory student internships in the second University year, involving practical task implementation, which include internship in different regional enterprises; (2) close academic and research interaction between departments and Institutes within the former Soviet Union and abroad (Kazakhastan, France, Czech Republic, Germany, Mongolia, China and other countries) which provide academic exchanges within the framework of the education program.

The most "weak point" in the criterion evaluation of the program is the provision of academic mobility. It is a known fact that the existing regulations and financial policy of a funded institution little do develop this aspect of the education program.

Nevertheless, report analysis indicated a positive dynamic concerning this question. While in 2004, there existed practically an epizoic student academic exchange and the recommendation was " systematize the activities in academic mobility through advanced development plan of practical training and internship in other institutes and universities, today, since 2010, academic mobility has become an integrated part of this or that education program and has been evaluated as a "strength". Until up to now, the recommendation remains "intensive scaling of student academic mobility, not only in domestic institutes, but also abroad".

Criterion 4. Faculty

Criterion requirements: The faculty should have a high qualification level, participate in R&D projects, and understand the role of his /her course in respect to the professional development of a specialist.

Tomsk Polytechnic University is proud of its faculty members, which, in its turn, has been unambiguously verified and emphasized in the reports of accreditation commissions. This criterion indicates "those tendencies and modifications in the education policy of a particular university and state in general."

In this case, in 2004, there were the following commentaries: " there are no instructors with academic degrees or ranks in those departments that are involved in foreign language teaching, physical training and military training..., ...The University should eliminate this gap..." or "....young instructors without teaching experience and no professional development in teaching methods are engaged in the program implementation..."; however, in the period from 2005 to 2009 this gap disappeared and the existing programs were relevant to the above-mentioned criterion.

For example, from 2010 the situation shifted. The typical commentary of expert commissions was the fact that there are so few instructors with doctor degrees who are engaged in the implementation of the education program.

In this case, the strengths of the education programs included no turnover in staff, practice experience in different spheres and active participation of the faculty in R&D projects.

Criterion 5. Professional qualifications

Criterion requirements: The program should provide engineering training during the study period. The graduates should attain competent knowledge in engineering disciplines, skills in engineering analysis, project management and etc.

This criterion is evaluated in accordance to great number of aspects and is usually distinguished by positive evaluation. However, in this case, there are weaknesses which could be only system gaps, but not the drawbacks of this or that program

One of the typical criterion requirements is the following expert commission conclusion" although the student's have knowledge in economic, ethic, socio-political, ecological issues, as well as, in labor safety and sustainable development, they do not apply this in their term papers and projects." In this case, it is recommended "to include these aspects in guidelines and instructions for term papers, projects and graduate qualification papers".

Typical recommendations of commissions embrace such an item as the development of teamwork skills in interdisciplinary topics, including the implementation of integrated team projects and graduate qualification papers and further evidence showing the student's abilities in pursuing professional engineering ethic code and norms, as well as, his / her responsibility to different engineering activities.

Student R&D activities is one of the most significant advantages of TPU and is consistently being evaluated by experts as a education program strength of the University in general.

Until strength of the TPU education program was the advanced training level in English for specific purposes.

Criterion 6. Facilities

Criterion requirements: The program's facilities should be relevant to licensing indexes, upgraded and appropriate to program educational objectives. The program should ensure that the facilities are consistently being upgraded and developing.

In 2004-2007 the expert commissions recommended the need to purchase upgraded analytical equipment and the establishment of university focused labs to maintain R&D activities.

After 2007 this criterion was highly evaluated by the experts. As a rule, the strength of education programs is the fact that the facilities include sophisticated domestic and foreign equipment and domestic software.

Criterion 7. Information infrastructures

Criterion requirements: Adequacy of computer resources support the attainment of program educational objectives and should be consistently upgraded and developed.

This criterion is usually positively evaluated by expert commissions. Many faculty members recommend required books out of 40-50 years in their course descriptions (annotations), while the adequacy of TPU library is relative to the needs of the program and faculty. In this case, the standard recommendation of expert commissions is the capability of the library to serve the program by obtaining modern courseware, domestic electronic education resources, including foreign ones.

Criterion 8. Finance and management

Criterion requirements: The financial support for the program should be relevant to licensing indexes. Financial and administrative policy should be adequate to ensure the quality and continuity of the program.

This criterion is usually positively evaluated by expert commissions. From time to time, if there are recommendations, they involve only Quality Management System (QMS), i.e. procedures in the upgrading of the University standard. One example recommendation was to specify the University program period and the annual procedure of its revision and approval.

Criterion 9. Graduates

Criterion requirements: Employment system and support of graduate careers should be involved in the continuous improvement of the program.

This criterion shows distinct positive dynamics. In 2004 it was recommended "..to develop a system of annual questionnaires for graduates within the framework of QMS..", while in 2007 it was noted ".... components for education program improvement are confirmed by graduate feedback."

During the past few years strength of the education programs is the existing well-established employment system. This fact shows that the number of employment applications is significantly more than the number of graduates, which, in its turn, provides job placement for all graduates. The introduction of an employee placement system (EPS) of on-site training and research internship for future student specialists enables employers to evaluate the training quality of specialists and establishes long-term mutually beneficial cooperation with Universities.

Based on the conducted research, it is possible to draw the following conclusions about university policy in development and implementation of educational programs:

1. Educational programs are developed and implemented in compliance with the needs and requirements of program constituents.
2. Program curriculum always aligns with the Degree Program educational objectives and supports the attainment of the student outcomes. The succession and the content of each course within the curriculum is thoroughly analyzed and defined in order to secure shaping of this or that students' professional competences. It is achieved through the application of vast amount of corresponding courseware including study manuals recommended by Education and Methodics Association and student assignment packages, contemporary teaching technologies, tools and equipment, as well as involvement of highly-qualified faculty members who are actively engaged in science and research. To secure continuous education quality enhancement, a number of regulative documents and University standards have been developed.
3. Cooperation with potential employers allows university to revise and modernize the existing curricula including student outcomes and program objectives in order to support the attainment of the required student professional competences acquired during internship and practice, which in its turn secures great demand of university graduates.

The analysis of the expert committee recommendations on the correspondence of educational program to the criterion requirements has revealed that the recommendations can be divided into two groups.

The first group reflects the current trends in Russia. A great number of aspects which are common place in international practice can be hardly implemented in Russian higher educational institutions due to the following reasons: economic, political, legitimacy gap in RF legislation system and etc. It concerns academic mobility

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assurance, student team work on interdisciplinary subjects including course papers and final qualification projects, etc.

The second group embraces the problems which can be solved by the university itself. They are as follows: increasing the number of doctoral degree holders, developing the code of professional ethics and regulations of engineering activity; covering economic, ethic, social-political, ecological and safety issues in course paper and final graduation project fulfillment, providing technical and informative support for various educational program implementation.

It is evident that public-professional accreditation is proved to be a real tool in assessing university performance. Effective application of this tool can help university to reveal its weaknesses and strengths, systemic errors and benefits.

REFERENCES

1. Pohkolkov Yu.P., Chuchalin A.I., Boev O.V. Engineering Training Quality Assurance: Educational Program Accreditation and Specialist Certification // Journal of Educational Studies. – 2004.-№ 4. – P. 125-141.
2. Chuchalin A.I., Boev O.V. Requirements to Engineering Graduates' Competences // Higher Education in Russia. № 9, 2007. P.25-29.
3. EUR-ACE® system [Electronic resource] // ENAEE : Europ. network for accreditation of eng. education: offic. site. – [S. l.]: cop. ENAEE, 2012. – URL: http://www.enaee.eu/eur-ace-system, free. – Tit. from the screen (usage date: 08.08.2013).
4. Accreditation Criteria [Electronic resource] // Accreditation center: offic. site / AEER. – [Tomsk, 2013]. – URL: http://www.ac-raee.ru/kriterii.php, free. – Tit. from the screen (usage date: 08.08.2013).

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Quality Assurance and Quality Enhancement in E-learning

National Siberian Federal University
S.A. Podlesny

Key words: *information society, e-learning, tendency, problems, quality assurance system, open educational recourses, criterions.*

The article examines the issues, challenges and possible solutions related to quality assurance in e-learning applied in engineering education.

S.A. Podlesny

E-learning (EL) is one of the fastest growing sectors in global educational environment. It is e-learning technology that is expected to change the teaching process itself. Such situation can be explained by the following reasons: development of post-industrial information society which is characterized by a wide spread of integrated processes based on the application of various information and communication technologies (ICT); free flow of information and knowledge; possibility not only to assure high education quality, but also to solve a number of social problems in order to provide the availability and transparency both of lifelong learning programs and education in general; constant teaching and learning quality enhancement. Of fundamental importance is a high degree of interactivity which makes it possible to provide information mobility, individual study path and timely updating of learning content. Therefore, quality assurance for e-learning technologies in engineering education is of vital importance. It should be noted that the requirements to engineering education content and teaching technologies are mainly defined by the external factors.

The main social and economic characteristics of post-industrial infor-mation society are substantially different from that of industrial one. This fact should be always considered in engineering education. Social and economic features are determined by such factors as economy globalization, sustainable development, high "living standards" and personal fulfillment [1]. A post-industrial society is a society in which an economic transition as occurred from a manufacturing based economy to a service based economy focused on individual demands. A great shift is observed in the principles of production organization and management – there are transnational corporations, e-enterprises and design-engineering offices which have no actual addresses and structures, but which actively apply information and communication technologies for integrating resources of the companies-partners scattered worldwide. A new type of production management occurs, i.e. product life cycle management based on continuous information support, as well as standardization of data submission through the application of CALS technologies. One of the technologies which are widely applied in science-intensive production is

Product Life Cycle Management (PLM). The integrated components of PLM are as follows: Product Data Management (PDM), Collaborative Product Development (CDP), Computer-aided Design (CAD), Computer-aided Engineering (CAE), and Manufacturing Process Management (MPM). The development of post-industrial economy is accompanied by the emergence of industry clusters which comprise interrelated high-tech enterprises, research and development companies, higher professional education institutions and innovative infrastructure. Implementing innovative technologies within high-tech production is the basic source of income. The products and services are becoming smarter and more knowledge based, which in its turn prompts high-tech production activity. Intellectual potential becomes a primary factor of production. There is the transition to the sixth technological mode which is characterized by nano-, bio- and ICT clusters. Thus, young engineers must become familiar with such professional environment which is inherent feature of post-industrial information society.

Global education trends are connected with the development of conceptually new system of open lifelong learning based on smart-technologies, cloud computing and social intelligence. Another fast growing technology is open education resources, i.e. digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research [2]. Open education resources developed by different universities are integrated into numerous information systems which form global campus networks [2]. The flagship in development and implementation of open education resources is Massachusetts Institute of Technology (MIT). To develop special content available for a wide range of users, social intelligence based on the Internet technology and Web 2.0 and Web 3.0 platforms are widely applied. The previous in-class learning is substituted by a new one based on e-learning technologies. One can witness the emergence of electronic universities which provide information support of educational process. International consortium "Electronic University" has been established. Different repositories which contain digital learning materials are developed in compliance with the existing education standards.

Today, e-learning programs are offered almost by all universities in the USA and South Korea as its quality is considered to be even higher than that of traditional ones. The United States of America has taken the first place at the fastest growing market in education, while Europe comes in second [3]. Since 2003 a new learning strategy eBologna ("Electronic Bolonga") aimed at developing special electronic environment for Bologna process has been successfully implemented. The European Foundation for Quality in e-Learning (EFQUEL) comprising universities, corporations and national agencies has been legally established. One of the main initiatives of the foundation is a new certification and quality improvement scheme for e-Learning courses and programs in international Capacity Building (Open e-learning in Capacity Building Check) [4]. A vast international experience on e-learning quality assurance has been gained: e-learning accreditation guidelines and quality standards (for example, criteria and certification process initiated by EFQUEL).

Majority of Russian universities have been falling behind in e-learning technologies, however, essential changes can be seen. First of all, the development of legal groundwork for e-learning programs has been launched. A new Federal Law "On Education in the Russian Federation" includes the following articles: "On implementation of Educational Programs based on E-learning and Distance Learning Technologies", "Network Educational Programs". This law regulates the

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implementation process of e-learning in higher education (availability of learning and information environment which includes electronic information resources, electronic learning resources, integrated information technologies and corresponding learning tools). Nominative legal acts aimed at regulating e-learning application in higher education are being developed. Special at-tention is paid to electronic learning resources, i.e. e-learning courses, e-learning training simulator and laboratory course, e-learning programs, e-learning assessment tools, e-library resources, remote databases and knowledge bases, etc.). The engineering training is mainly based on the application of so-called hybrid (mixed) learning technology which unites traditional and e-learning approaches. However, this fact does not eliminate the necessity of developing adequate learning and information environment.

The analysis of worldwide and Russian trends in higher professional education has revealed that university learning and information environment should be created considering the following principles (Table 1).

A number of Russian universities (Moscow State Technical University n.a. N.E. Bauman, Moscow Power Engineering Institute) gained considerable experience in e-learning implementation. For example, Moscow State Technical University n.a. N.E. Bauman has introduced interactive training methods into education process to increase the efficiency of ICT application [5]. Students are taught to fulfill engineering tasks at all stages of product life cycle based on the innovative educational framework developed by Massachusetts Institute of Technology in cooperation with scientists, faculty members and industry representatives. The framework is designated to provide students with engineering fundamentals set in the context of "Conceiving — Designing — Implementing — Operating" [6]. Besides, students are involved in learning content development that contributes to shaping required competencies and skills. Some universities apply Siemens PLM Software, i.e. leading worldwide supplier of PLM-technologies [7].

Laboratory classes are of vital importance in engineering education. In this regard, a great deal of work has been done in Siberian Federal University where faculty members developed automated remote-access laboratory practicum based on net multi-user on-line access to the lab equipment through a single network access point – automated and virtual portal of laboratory practicum. Such type of laboratory practicum is based on the concept proposed by Krasnoyarsk State Technical University [8]. On the basis of this concept, computer measurement tools National Instruments and gained experience, a number of software packages and unified flow diagram of automated remote-access laboratory practicum have been developed (Fig. 1). Portal design in terms of functional components (special network laboratories, departments and common use centers, remote access software packages, etc.) provides the possibility to adapt its virtual space to the assigned task.

It has become obvious that developing remote-access software packages implies not only such challenge as selection of appropriate software technology but also development of multi-component software guidelines. These problems should be solved with the systemic approach which allows integrating all components into the unified information and science learning environment.

The development of training e-enterprises as a part of information and science learning environment is also of current interest. Such e-enterprises are designed by integrating administrative and technical resources of various university units (e-enterprise flow diagram developed by Siberian Federal University is given in Fig. 2). These e-enterprises are oriented to train such engineers who are capable of working in

Table 1. Principles of University Learning and Information Environment Management

Principle	Description	Result
1. Fundamentality of educa-tion due to in-depth study of Mathematics and Physics	Fundamental and systemic approaches in learning mathematical aspects of infor-mation technologies and physical effects in engineering	Solving engineering problems based on synthesis method
2. Consistency in Information Technology application	Development of a conceptual sustainabil-ity-driven curriculum covering all neces-sary material concerning ICT application with a progressive sequence	In-depth and system-ic knowledge in ICT within engineering topics
3. Relevance and priority-oriented	The content of the curriculum should be aligned with the priority areas in science and engineering and based on the recent achievements in the relevant subject areas in order to provide knowledge acquisition ahead schedule	Correspondence of learning environment with the re-quirements of econ-omy, labor market and professional community
4. Availability of network technologies in production process design	Collective method application in ICT-based technical production	Knowledge and skills in E-design offices and Industrial Virtual Enterprise
5. Multilinguality	In-depth learning of foreign languages, es-pecially English language (fluency)	Participation in inter-national projects. Ex-port of educational services
6. Orientation on international standards	Orientation on the international standards which provide storage of process and ob-ject models corresponding to different stages of product life cycle in a formalized manner	Development of com-petitive technical products in network economy
7. Economic efficiency	Consideration of basic economic parame-ters in learning environment development	Learning environment economic efficiency and circulation
8. Multifunctionality and adaptability	Convertibility of learning environment in accordance with the current objectives and individual peculiarities of a student	Teaching quality increase and education cost reduc-tion
9. Practical orientation	Application of math modeling and simula-tors in lab classes. Development of e-learning resources in compliance with em-ployer's requirements	Knowledge and skills in engineering prob-lem solving. Model-ing of true-to-life production processes
10. Modularity and person-centered learning	Development of module-based curriculum which allows students to choose individual study paths	Learning environment flexibility, orientation on students' peculiari-ties, needs of econo-my, labor market and professional commu-nity
11. Marketability	Development of information and learning environment based on the best national and foreign experience	World competitive in-formation and learn-ing environment

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multidisciplinary teams and moving the profession forward.

Major issues affecting e-learning in Russia are as follows:

- absence of e-learning development strategy which is required to enhance forward-looking engineering education;
- insufficient investment quotes;
- insufficient e-learning methodology;
- low competence of faculty members in e-learning technologies;
- ill-defined e-learning quality assessment policy;
- unconformity in the existing university quality systems and e-learning peculiarities;
- absence of strategy in e-learning quality problem solution.

E-learning pedagogies must incorporate new learning environment, teacher-student interactive behavior patterns, up-to-date approaches to outcomes assessment, etc. Faculty members should have deep knowledge not only in corresponding subject areas, but also e-learning technologies and tools.

When introducing e-learning into teaching process, special attention must be given to education quality. The factors which can influence e-learning quality can be divided into two groups: external and internal [10]. The external factors are those which are outside of e-learning process (political, social, demographic, and economic). The internal factors occur within university and have direct influence on e-learning process (university e-learning policy and strategy, quality of information and learning environment, level of student-teacher competency in IT and etc.).

To provide high quality of e-learning within engineering training, it is necessary to assure the quality at every stage of educational process and implementation of effective quality system. In accordance with National State Standard (P53625-2009 (ISO/MEK 19796-1:2005), life cycle processes as applied to e-learning are

Fig. 1. Unified Flow Diagram of Automated Remote-Access Laboratory Practicum based on National Instruments technologies

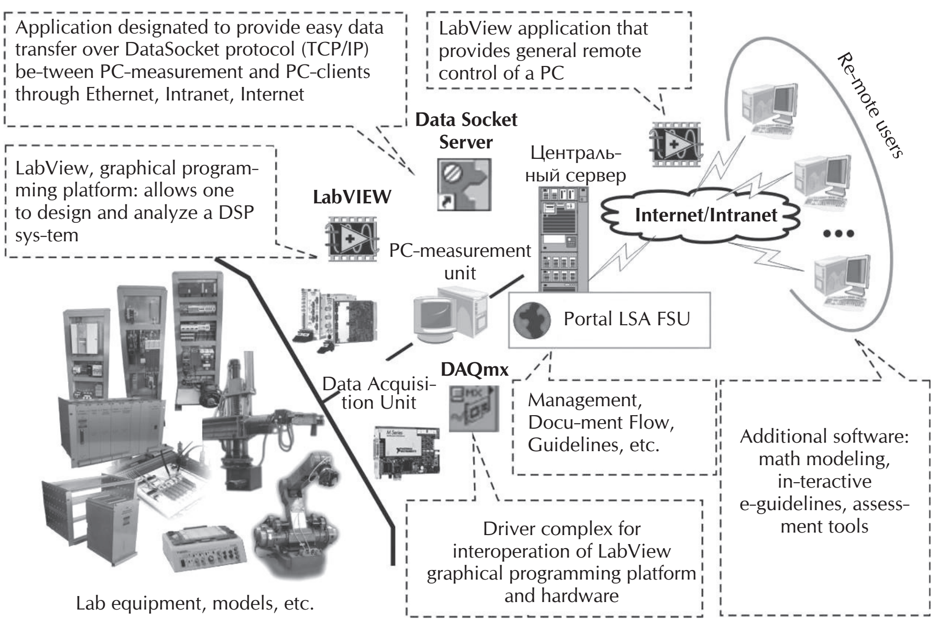

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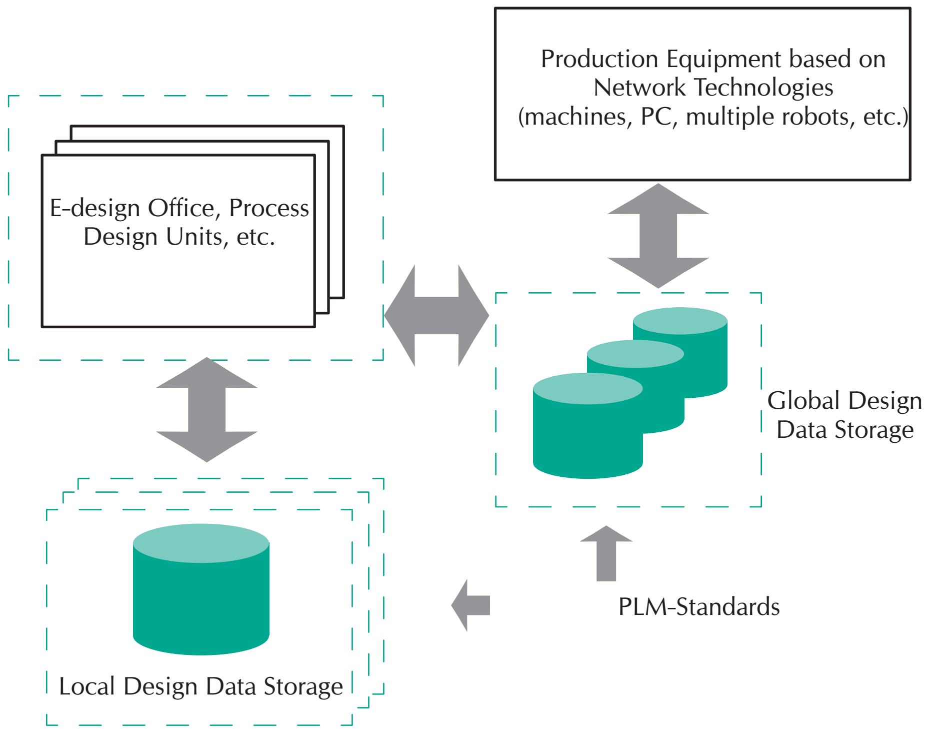
Fig. 2. (Net) E-enterprise Flow Diagram



as follows: needs analysis–structure analysis–concept/project–development/ implementation–training–assessment/ optimization. Apart from Federal Education Standards and Professional Standards, effective university quality system can be based on European standards and guidelines for internal quality assurance within higher education institutions ENQA [10] and e-learning quality standards. According to ENQA standards and guidelines, university quality system comprises three subsystems: quality assurance, quality monitoring and management.

Quality assurance subsystem based on hybrid technology should include:

- learning quality assurance policy;
- educational program requirements and standards;
- facilities requirements for the departments involved in implementing degree programs;
- information and learning environment requirements;
- courseware requirements;
- requirements for program constituencies;
- requirements for educational services suppliers;
- local nominative acts for education quality assurance.

E-learning quality to a significant extent defines competitive advantage of higher professional institution.

Therefore, interaction of universities with various organizations focusing on quality assurance in e-learning is of vital importance, they are as follows:

- The Agency for Higher Education Quality Assurance and Career Development.
- The European Association of Distance Teaching Universities (EADTU).
- The European Foundation for Quality e-Learning – EFQUEL (provides accreditation and quality improvement scheme for E-

Learning programs and institutions promotes and implements e-learning technologies, develops inter-university e-libraries, etc.).

- Association "Education in Information Society".

One of the mechanisms of e-learning quality assurance is an integrated review of e-learning resources, which should include the following stages: content analysis (relevance, correspondence with educational program, presence of multimedia resources and interactivity, monitoring, etc.), software audit (software implementation, functional parameters, interface indicators, observance of international standards, etc.), design and ergonomics examination (spatial layout of the information, quality of multimedia components, easy navigation, etc.).

Possible criteria of e-learning quality assessment:

- education quality (training "in-demand" specialists);
- quality of university information and learning environment components;
- meeting the requirements of the parties concerned;
- international accreditation of educational program;
- efficiency of applied software tools;
- quality of nominative acts for e-learning regulation.

The following conclusions can be drawn from the present study:

1. E-learning should be regarded as one of the guaranties of engineering education quality assurance.

2. E-learning quality policy should be based on standardization and certification. A special infrastructure which involves voluntary certification has been already established.

3. Universities must develop further training courses aimed at upgrading faculty qualification in e-learning technologies.

4. There is a vital necessity to train e-learning experts, establish departments and academic units focused on developing e-learning resources.

REFERENCES:

1. Agranovich B.L. Challenges and Solutions: Master's Student Training for Post-Industrial Economy // Engineering Education.–2011.–№8.–P.56-61.
2. Dneprovskaya N.V. Open Educational Resources as the Basis for Global University Network Development // Open Education.–2009.–№2(73).–P.27–33. only in Russian.
3. Ilyushin S. Information, Education, Mobility // Education Quality.–2012.–№9.–P.8-9. only in Russian.
4. Soboleva E. Competency Development through E-learning // Educa-tion Quality.–2012.–№9.–P.10-11. only in Russian.
5. Filippovich A. Information and Communication Technologies: Teacher-Student Interactive Methods // Education Quality.–2012.–№9.–P.40-45. only in Russian
6. CDIO Standards [Electronic resource]: – Access mode: http://www.cdio.org, free. – Title from the screen.
7. Siemens PLM Software [Electronic resource]: – Access mode: http://www.siemens.com/plm, free. – Title from the screen.
8. Podlesny, S.A. Patterns for Automated Remote-Access Laboratory Practicum Development (Radio-Engineering Programs) // S.A. Podlesny, A.V. Sarafanov, V.A. Komarov.–Krasnoyarsk: KSTU, 2005.–40 p. only in Russian.
9. Razumovsky D.V. E-learning: Quality Factors // Open Education.–2009.–№2(73).–P.79–85. only in Russian/
10. European Standards and Guidelines for Quality Assurance within Higher Education Institutions [Electronic resource]: – Yoshkar-Ola: Accreditation in Education, 2008. — 58 p. – Access mode: http://www.enqa.eu/files/ESG_v03.pdf, free. – Title from the screen.

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Professional and Public Accreditation as an Integral Part of Education Quality Improvement

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Key words: design, employers, local educational programs, resumes.

The article outlines the experience of being an expert in professional and public accreditation. Basic elements of accreditation, which attempt to improve engineering training quality in contemporary world, are explained.

R.M. Pecherskaya

Training of highly-qualified and dedicated engineering staff to meet engineering industry requirements is currently characterized by a number of peculiarities. This is explained by rapidly changing world of manufacturing and rising costs for design, production and maintenance.

Professional and public accreditation of educational programs is designated to ascertain that specialist's, bachelor's and master's programs provide qualitative training of engineers who are capable of adapting to professional work practice, working in a multidisciplinary teams and generating non-standard solutions to fulfill the task. As a rule, faculty members and students of the university seeking accreditation are open to cooperation with AEER representatives even during consultative visit when "bottlenecks" of the program are detected and possible non-standard solutions are proposed.

The cooperation with potential employers and study of relevant industrial enterprises can help to bring students and their instructors together. In this very moment the feedback becomes so obvious that it eliminates such natural question as "What does professional accreditation give? That is just the way educational programs provided by Kazakh National Technical University after K.I. Satpaev (050713 "Transport, Transport Equipment and Engineering", 050716 "Instrument Engineering", 050719 "Radioengineering, Electronics and Telecommunications"), and Togliatti State University (140211.65 "Electrical Power Supply", 150202.65 "Welding Equipment", 151001.65 "Mechanical Engineering Technology") were accredited.

In this respect, a consultative visit of professional and public accreditation experts to Siberian Federal University seeking accreditation for such programs as 210300.68.04 "Microwave Engineering and Antennas", 230100.68.02 "High Performance Computin" is a vivid example of such feedback which has revealed that strategic partners are really involved in curriculum revision and modernization while professional component defined by university is in compliance with local industry and business needs [1].

The presence of lab guidelines and practice class plans provide significant contribution to understanding of curriculum scope and sequence, as well as contemporary engineering trends and innovations [2].

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Different information technologies are also of great importance in engineering training. Let us consider the example of Bachelor's and Master's programs offered by Faculty of Power Energy, Nanotechnology and Radioelectronics of Penza State University. The faculty offers the following degree programs: 210100.62 (68) «Electronics and Nanoelectronics», 210601.65 «Radioelectronic Systems and Complexes», 211000.62 (68) "Electronic Equipment Design and Manufacturing", as well as 280700.62 "Technosphere Safety" and Bachelor's program 140400.62 "Power and Electrical Engineering" (since January 1, 2013).

The curricula of the above-mentioned programs include courses in Materials Science and Technology. In the context of scientific school "Microelectronic and Information Technologies in Materials Science and Functional Electronics" (supervised by Doctor of Science, Professor R.M. Pecherskaya), automated complexes for lab classes in "Electronic Equipment Materials", course paper and final project fulfillment have been developed. These automated complexes allow students to examine electro-physical parameters of the materials for nanoelectronics and microelectronics which have evolved through 8 generations since 1992 (Fig.1-4).

Training and research complexes designated to provide temperature, field and frequency measurements consist of hardware and software [3].

Such kind of inventions is widely applied in more than 130 universities, including National Research Universities, in Russia and its neighboring countries.

The complexes were developed based on the analysis of program curriculum and in compliance with the existing Federal Education Standards.

The quality of engineering training is improved due to the following reasons: remote education access; flexibility in curriculum content, study mode and program length; fundamental learning process and development.

While doing research or qualification project, a student has a possibility to acquire various data, i.e. reference or legal materials.

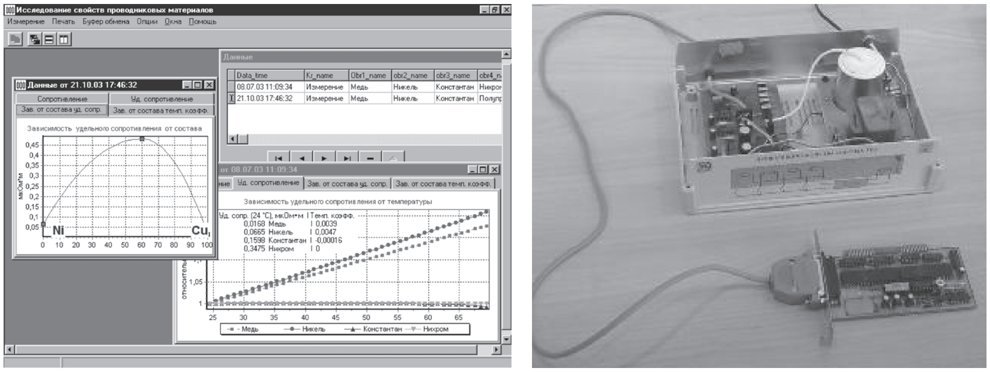
The investigation of dynamic processes accompanied with multi-channel measurements, storing and further mathematical processing of parameters to regulate production mode is provided during the experiment.

Fig. 1. Automated Complex Layout (1992 – 1998)

Fig. 2. Automated Complex Layout (1999 – 2002)

Fig. 3. Automated Complexes for Measuring Volt-Ampere (a) and Voltage-Capacitance Characteristics (б) of Microsystems

Fig. 4. Automated Complex for Single-Component and Multi-Component Conductor Material Study



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Professional and public accreditation is an effective management tool which allows university authorities to enhance education technologies and learning strategies applied in various curriculum subject areas; reveal new approaches to educational program implementation including student and faculty mobility.

REFERENCES:

1. Lobanov G.Kh., Olejnik L.F., Pesotstky Yu.S., Pokrovsky K.K. Analytical Report on Analysis Results Conducted by Lomonosov Moscow State University within the Framework of National Project "Education". M.: OPORA Rossii. 2007- 70 p. [P. 2] (only in Russian)
2. Volchikhin V.I., Averin I.A., Karmanov A.A., Pecherskaya R.M., Pronin I.A. Innovations in Nano- and Microelectronics Development if Penza State University // High School Engineering: proceedings of XVII International Scientific Methodological Conference Dedicated to 70th anniversary, Issue17. – Penza: PSU, 2013. – P.7 [p. 2] (only in Russian)
3. Semiconductive Structures and Devices (Automated Lab Practicum) / Volchikhin V.I., Karpanin O.V., Madvedev S.P., Metal'nikov A.M., Pecherskaya R.M., Varenik Yu. A. – Penza: PSU, 2013.-172 p. [c. 3] (only in Russian)

PUBLIC HEARINGS "PROFESSIONAL AND PUBLIC ACCREDITATION OF ENGINEERING EDUCATIONAL PROGRAMMES"
May, 28,2013 – St. Petersburg

Organizers:
Association for Engineering Education of Russia
St.Petersburg State Polytechnical University
Tomsk Polytechnic University

The main purpose of the public hearings was to draw the attention of professional society to development of professional and public accreditation of engineering programmes as the key element of quality assurance system in engineering education.

More than 40 participants such as members of the Council of the Federation ,rectors and vice-rectors of universities implementing engineering educational programmes, industry, scientific and educational community representatives took part in the event.

Among the key-note speakers were Prof. Yury Pokholkov, President of the Association for Engineering Education of Russia, Mr. Viktor Kress, Deputy Chair of the Committee on Education, Culture and Information Policy of the Council of Federation.

Participants of the public hearings had an opportunity to get acquainted with international and Russian experience in professional public accreditation of engineering educational programmes. Some legislative aspects, advantages and disadvantages of the current system of professional public accreditation, its important role in improving the quality of engineering education were considered within the hearings.

The need to hold the hearings was also associated with the adoption of the Federal Law "On Education in the Russian Federation" № 273FZ on 29/12/2012 enter into force on 1st September 2013. The participants of the hearings noted imperfection of the Article 96, which describes the basic principles of public accreditation of educational programmes in higher educational institutions of Russia, in particular:

- lack of clearly stated requirements to the accrediting organizations;
- foundation of National Register of accrediting organizations is not foreseen;
- no measures to encourage engineering universities in Russia to present educational programmes for undergoing the procedure of professional public accreditation.

As a result of discussions, a number of proposals were made to amend the existing revision of Article 96 of the Federal Law "On Education in the Russian Federation" № 273FZ, and some recommendations on how to improve the system of professional public accreditation were developed.

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RECOMMENDATIONS OF THE PUBLIC HEARINGS “PROFESSIONAL AND PUBLIC ACCREDITATION OF ENGINEERING EDUCATIONAL PROGRAMMES”

St. Petersburg
May 28, 2013

The public hearings were attended by members of the Federation Council of the Russian Federation, heads of universities implementing engineering education programs, members of the Association for Engineering Education of Russia, representatives of employers and academic and research community.

General characteristics of the problem

Professional and public accreditation is one of the main elements of the quality assurance system for training in the field of engineering and technology. Association for Engineering Education of Russia has been conducting professional public accreditation of engineering educational programmes since 1997 in accordance with international requirements. AEER membership in the world’s most influential alliances such as Washington Accord, ENAEE is the best confirmation for this fact. Within the recent years 222 engineering educational programmes were accredited by AEER (including awarding of the common European quality label - EUR-ACE® label to 141 Programmes) in 33 Higher Education Institutions (HEIs) of Russia and 7 HEIs of Kazakhstan.

The relevance of the work to improve the system of professional public accreditation is mainly caused by the need to improve the competitiveness of engineering education due to Russia’s accession to the WTO. At the same time, today there is not any National Register of those organizations conducting professional public accreditation in Russia.

Analysis of the state-of-the-art indicates a number of difficulties the system of professional public accreditation has faced, which are caused by:

- low motivation of universities to undergo professional public accreditation;
- inadequate representation of the processes of professional and public accreditation of educational programmes in the approved version of the Federal Law “On Education in the Russian Federation” (Article 96);
- lack of Russian system for certification of professional qualifications.

Given the seriousness of the problem being discussed and the need to take effective measures for the development and improvement in the National system of professional and public accreditation of engineering educational programmes (internationally recognized), participants in the public hearings recommend:

Government of the Russian Federation:

1. To take measures to form the National Register of organizations conducting professional public accreditation and Register for certification of professional qualifications.

Ministry of Education and Science of the Russian Federation:

1. To take measures to improve the motivation of engineering universities of Russia to undergo procedures of professional public accreditation.

2. To develop instruments, considering legislative issues, regulating the recognition of the results of an independent evaluation of educational programmes in engineering and technology within the process of state accreditation.

3. To consider allocating funds in the budget funding of universities for the costs of preparing and carrying out professional and public accreditation of engineering educational programmes by accrediting organizations included in the National Register and international alliances.

4. To provide access to the data of National Register on engineering educational programmes that have received international professional public accreditation on the website of the Ministry of Education and Science of the Russian Federation Registry.

Federation Council of the Russian Federation,
State Duma of the Russian Federation:

1. To develop amendments to the Federal Law "On Education in the Russian Federation" and the new draft law (Law "On the engineering profession"), contributing to the enhancement of professional and public accreditation of engineering educational programmes, including:

- To provide a number of preferences in passing state accreditation procedure to those Higher Educational Institutions that have successfully obtained internationally recognized professional public accreditation of educational programmes.
- The results of professional public accreditation of educational programmes should not just be considered (according to the Federal Law "On Education" Art.96), but taken into account within the state accreditation process.

Russian Union of Industrialists and Entrepreneurs, involving stakeholders:

1. To ensure and promote towards development of professional and public accreditation in Russia, including:

- Contribute to national and regional centers of professional public accreditation of educational programmes and certification of professional qualifications.
- To sign agreements to authorize national and international accrediting organizations and professional associations, members of the National Register, to carry out professional public accreditation of engineering educational programmes.
- To develop requirements for accrediting organizations that may be delegated powers (authorized) to carry out professional and public accrediting activities of engineering educational programmes.
- To continue efforts in developing professional standards (quality requirements for training in the field of engineering and technology).

Heads of HEIs training engineers and specialists in the field of engineering and technology:

1. To submit educational programmes in engineering and technology to domestic and international accreditation agencies (members of the national Register) for public and professional accreditation.

State and public organizations interested in improving the quality of engineering education in Russia (Association of technical universities, Association of civil engineering universities, etc.):

1. To contribute to enhancing ideas and mechanisms of national and international professional and public accreditation of engineering educational programmes.

Mass media:

1. To promote scientific and educational programs and publication of papers that explain the principles of professional and public accreditation, the need for and effectiveness of the independent evaluation of engineering educational programmes as a tool to ensure the quality of training in the field of engineering and technology.

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70-YEAR HISTORY OF ENGINEERING EDUCATION IN ALTAI

I.I. Polzunov Altai State Technical University
V.D. Goncharov, A.A. Sitnikov, O.Yu. Sartakova

Key words: Engineering Education, Altai, I.I. Polzunov AltSTU

The article presents the historical view of engineering education development in Altai. 70-year history of I. I. Polzunov Altai State Technical University is described.

V.D. *Goncharov*

A.A. Sitnikov

O.Yu. Sartakova

It was severe December,1941 when the whole country lived under the slogan of the famous Soviet song "Sacred War":

«Rise up, tremendous country!
Rise up for the mortal fight
Against the dark fascist forces,
Against the cursed hordes!
May the noble fury
boil over like a wave.
The people's war is on its way
The sacred war!...»

And it was at this time when 12 faculty members and 20 students of Zaporozhskiy Engineering Institute together with their Director, Leonid G. Isakov [1, P. 16-22], arrived in Barnaul in two carriages of special evacuation train. On February23, 1942 the Director issued an Order that resumed the classes despite the fact that the premises which were provided by local authorities for teaching accommodation were still being renovated. Under such heavy conditions, the studies were started. A month later, in March 1942, the first 77 students, evacuated from Moscow Auto Mechanical Institute along with their instructors, were enrolled in the first/second and third year of the Institute programs. It was Moscow students who became the first enrollment of the third Institute department –Department of Automobiles and Tractors. By May 1942,12 departments, with total number of faculty members reaching 27, had been established (Department of Mechanical Engineering Technology, Metal Technology and Metallurgy Department, Department of Strength of Materials and Machine Elements, Mechanics Department, Power Engineering and Automotive Industry Department, Department of Mathematics, Chemistry Department, Physics Department, Department of Marxism-Leninism, Department of Foreign Languages, Department of Military Training and Department of Physical Training).

Certainly, the most difficult task, i.e. to solve the problems in student and faculty housing, as well as setting up of Institute studies, fell on the Director and academic staff evacuated from Zaporozhye. Associate professor N.A. Govorov, a full brother of a legendary Marshal of the Soviet Union L.A. Govorov, was appointed as Dean of Mechanical Engineering Faculty. Associate professor V.P. Ilyachenko became a Head of Metal Technology and Metallurgy Department, while associate professor A.E. Gurvich accepted the call to become a Head of the Department of

Strength of Materials and Structures and agreed to manage scientific research and development in the Institute. Assistant Professor L.P. Leonov became a Head of Mathematics and Physics Department. Then, the Department of Mathematics became a separate academic unit and was headed by Doctor of Physics and Mathematics, Professor I.P. Natanson. He occupied this position up to 1944. When the Soviet troops fully lifted the siege of Leningrad, he returned to the Institute where he worked before. For a great number of Soviet students, his High Mathematics book became an indispensable guide for many years. The total number of students enrolled in fall 1942 was 484, in 1943 -389 students and in1944- 326 students. At war-time, the number of students varied as a result of academic failure, however, it was not the only reason, for example, in 1943 approximately 200 students went off to war as they had no any occupational determent. During the 1944-45 academic year, many students returned to their home towns and regions which were released from occupation by Soviet soldiers. At this time, enrollment at the University swelled from the influx of young veterans, wounded men, as well as former students and instructors who survived and returned home. During the toughest and the most difficult years of World War II, from 1942 to 1945, Leonid G. Isakov, Director of the Institute, and faculty members ensured by the support of local authorities, managed to provide training of qualified engineers with the requirements of Altai defense industry. There were only 43 faculty members at all. In December 1943, the university was renamed as Altai Engineering Institute (AEI) in accordance with Government Order. On June 16, 1943, the regional newspaper "Altaiskaya Pravda" published an article about the first 13 graduates of Altai Engineering Institute, where it was stated that "Barnaul Mechanical Engineering Institute can become and will become a real talent foundry which can prepare qualified industrial leaders for the country". Twenty years later, those proved to be fatidic words when Vasily G. Radchenko became the Head of the Institute and turned it to the "alma mater of engineers" in Altai [1, P. 32, 62]. University facilities were also expanding. In 1943, the second housing area optimized for 100 students was constructed (the construction was completed by its own efforts next year, in January), the third housing area for students, instructors and institute staff was constructed in 1944. Besides, a number of laboratories and classrooms were built. The fund of the library numbered about 8 thousand volumes. Construction and renovation were made without any assistance. The Komsomol Committee formed groups of carpenters, plasterers and house-painters, which were comprised mainly of students and faculty members.

The year of 1947 saw a number of significant happenings. On September 4, in accordance with the Order of the Minister of Higher Professional and Vocational Secondary Education of the USSR, Altai Engineering Institute was reorganized into Agricultural Engineering Institute. At this time, there were 47 full-time instructors and 9 part-time instructors (only one professor, P.V. Melentiev, and 4 associate professors) who worked at 12 departments. Leonid Isakov, Director of the Institute, was conscious of the fact that to enhance prestige of the Institute and to improve educational quality, it was required to increase the number of highly qualified staff. Therefore, he and Deans of the faculties were actively involved in solving staffing problems. At this time, a number of engineers with Candidate Degree and vast industrial experience were employed in the Institute: I.V. Burgsdorf became a Head of Metal Technology and Metallurgy Department and worked as Vice-Rector for Research and Development from 1949 to 1965. A.D. Vorobieva and A.V. Gandler became the heads of the Departments of Chemistry and Mechanical Engineering Technology, respectively. Honors students graduated from the Institute in post-war years were invited to stay involved in the life of the university and to remain engaged with their faculty.

During these ten years (from 1942 to 1952), Agricultural Engineering Institute prepared 536 qualified specialists with high professional education to meet the needs of defense industry and national economy not only of Altai, but the whole Soviet Union. The credit of this noble deed was due to Leonid G. Isakov, Director of the Institute.

В эти годы начато строительс-тво учебOn May 20, 1952 Associate Professor, Candidate of Technical Science, Konstantin D. Shabanov was appointed to the position of the Director of the Institute (1910-1963) [1, P.23,31]. The task that faced him was not only to push the matter through but also provide sustainable development of the Institute. The main problems that the Institute had to solve were as follows: lack of possibility to improve poor educational and operational support facilities, shortage of enrollees and as a result non-competitive admission to the Institute, for example, the enrollment plan for 1952-1953 academic year was 200 students, however, only 170 entrance applicants were submitted. In 1952, the Institute celebrated its 10th anniversary. By this time 13 departments and 2 faculties (Faculty of Tractor Industry located in Barnaul and Faculty of Agricultural Engineering located in Rubtsovsk) had been established. There were 6 buildings, 5 of which were heated with furnaces, 18 laboratories and offices.

The Institute staff and students were engaged into different kinds of re-search and development work. For example, the first collection of AEI scientific papers was published in1952, the second one – in 1957.

Due to the fact that industrial plants and agricultural industry were rapidly developing after breaking new ground and fallow lands in Altai, there appeared an urgent need for engineers of chemical, energetic and mechanical engineering industries, as well as specialists in grain storage and processing, construction and design of lift conveyors, machines and instruments for food-manufacturing industry. On May 20, 1959, Council of Ministers of the USSR adopted a Regulation establishing Altai Polytechnic University. A month later, Agricultural Engineering Institute was renamed as Altai Polytechnic Institute (API) in accordance with the Order of the Minister of Higher Professional and Vocational Secondary Education of the USSR. 500 thousand roubles were granted to purchase teaching laboratory resources and classroom equipment. At that time, this sum of money was rather immense as, for example, a turning lathe cost 2 thousand roubles, while the prices for drills, cutters and millers varied from 10 kopecks to several roubles.

During the period from 1959 to 1960 there were also a number of significant events. On June 22, 1959, two new faculties were established: Faculty of Construction and Faculty of Chemical Engineering. Four Degree Programs were developed and introduced: "Industrial and Civil Construction", "Engineering Construction Manufacture", "Welding Equipment and Technology", "Machinery and Metal Processing methods'. In June, the construction of educational building and two dormitories for 500 and 516 students was started. In August 1959, in accordance with the Decree of Regional Executive Committee of Communist Party of the Soviet Union, a new four-storeyed building intended for Regional Party School was granted to the Institute. In September 1959, there were 2500 students studying at four faculties which offered 11 degree programs. The academic staff numbered 147 full-time instructors, 18 of whom were Candidate's degree holders. However, there was no faculty member who held a Doctor's Degree. Enrollment in the fall of 1959 totaled 650 students, with full-time enrollment being 525 students and evening tuition – 125 students. On Oc-tober 12, the number of academic staff members elected to the Academic Council was approved. Also, in October, the Institute initiated construction of the main building in the sandy waste land (14,4 hectares) where there was a small wood called by people "Dunkina" at the beginning of the XXth century. Under 8-year leadership of Konstantin D. Shabanov, the Institute became a famous higher professional establishment far from the central part of the country, which not only provided high quality training, but also carried out in-depth scientific

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Table 1.2. Number of Students and Graduates in First 10 Years

Academic Year	Student Num-ber (person.)	Student Number (person.)	Academic Year	Student Number (person.)	Graduated Engineers (person.)
1942–1943	360	13	to 1.09.1949	721	72
1943–1944	389	13	to 1.09.1950	764	79
1944–1945	326	17	to 1.09.1951	856	94
to 1.09.1946	375	9	to 1.09.1952	911	140
to 1.09.1947	447	51			
to 1.09.1948	711	78		Total	536

Table 2.1. Student Enrollment and Number of Graduates in 1952–1960.

Year	Student Enrollment	Number of Graduates	Year	Student Enrollment	Number of Graduates
1952	911	139	1956	More than 1500	128
1953	937	98	1957	More than 1600	192
1954	1266	115	1958	More than 1800	236
1955	1480	133	1959	More than 2500	264
			1960	More than 3000	352
				Total	1657

research. Student enrollment is given in Table 2.1.

When Konstantin D. Shabanov abandoned his post, Vasily G. Radchenko, laureate of the Lenin Prize in Science and Technology, was appointed to the position of the Director of the Institute in accordance with the Order of the Minister of Higher Professional and Vocational Secondary Education of the USSR [1, P.32, 62]. With his natural activity, he got down to business and concentrated all his efforts on developing large professional institute in the South of West Siberia. At the end of 1960, the Institute comprised 4 faculties, 17 departments; the teaching staff included about 147 full-time faculty members, however, only 18 instructors were Candidate's degree holders and more than 70 instructors took the position of teaching assistants. Therefore, on December 9, 1960, under the chairmanship of Konstantin D. Shabanov, Academic Council took a decision to decrease teaching load of those instructors who were engaged in scientific research. Those young and perspective specialists were sent to participate in various post-graduate programs offered by Professional institutions and universities of Moscow, Leningrad, Tomsk, Voronezh, Saratov, Kazan, Sverdlovsk.84 faculty members entered post-graduate program in 1960, 1961 and 1962. In September 1960, the first Sambo sport club was established. In accordance with the Order of Minister of Higher Professional and Vocational Secondary Education of the USSR (from May 26, 1961), the institute was named after I.I. Polzunov, a talented Russian inventor of the first steam engine. The year 1961 involved many significant events which were important for the advancement of the sciences in the Institute. One of them was the establishment of the first post-graduate program. By September 1, 1961 there were 3823 students in Altai Polytechnic Institute, 2147 of them were full-time students and 708 evening students pursuing Degree in Barnaul, 268 evening degree students – in Biysk, 700 evening degree students – in Rubstovsk. In March 1962, Faculty of Extension was established. During the next three months, 6 new departments were created. A new Degree Program "Internal Combustion Engines" which was previously offered by Tomsk Polytechnic Institute was introduced in API. To ensure successful program implementation, a distinguished scientist, Professor V.K. Nechaev was invited to API. His arrival became a powerful incentive to the advancement of sciences in API.

In September 1, 1963 there were 4979 students (2528 full-time students) studying at 28 departments. The teaching staff numbered 296 instructors, including 3 Doctor's Degree holders. The main building of the Institute had been constructed by the beginning of the 1964-1965 academic year. This building housed 34 lecture rooms, conference and sport halls, and a library with a reading room, with total capacity being 450 seats. Construction of 2 dormitories was completed in 1963 and 1964. Besides, a canteen for 300 persons was built in1964 and the construction of a two-storeyed lab building was completed in December 1965. At this time, the Institute had 10,000 m^2 of educational and industrial premises. It should be noted that a special Community Service Office was organized by API Communist Party, which was headed by the Dean of Chemical Engineering Faculty, Associate Professor, L.A. Gerlakh. It is impossible to overstress the importance of this organization. About 2000 students and faculty members were involved in the construction of the main building of the Institute in summer of 1964. In general, students and their instructors devoted ap-proximately 120000 hours of their personal time to the construction the Institute buildings in 1964.

This year the construction of the first Computer Center in Altai intended for mechanization and automation of research, mental and scientific work was initiated. In 1968, more advanced computer model "Minsk-22", which could be found not at every university of the country, was obtained. In January 1966, the Institute employed 450 instructors, 63 of them held academic degrees.

One of the most significant events took place on January 10, 1967 when API hosted All-Soviet Union Symposium dedicated to 200th anniversary of the first steam engine invented by I.I. Polzunov and 25th anniversary of Altai Polytechnic University. Among participants of the symposium there were academicians of Siberian branch of USSR Academy of Sciences, i.e. its chairman – M.A. Lavrentiev, S.S. Kutateladze, V.V. Struminsky, A.V. Okladnikov, first secretary of Regional Communist Party – A.V. Georgiev, chief engineer of "Transmash" factory – L.V. Markin, chief designer of Barnaul Boiler Factory – N.V. Pavlov. More than 500 scientists from different towns, leading specialists, directors of various factories, API alumni attended the plenary meeting of the symposium. In 1970, three new departments were established: «Technology of Grain Storage and Processing», "Food Industry Machines and Instruments", "Economics and Industry Engineering". Biysk Affiliated branch of API launched the first full-time degree program "Chemical Plant Equipment". Altogether, the number of specialists graduated from the Institute this year was 1227, the total number of students was 9157 (full-time students – 4812). Under 12-year leadership of V.G. Radchenko, 10464 highly-qualified engineers graduated from the Institute.

One of the most important tasks was also to train qualified academic staff – candidate's and doctor's degree holders, professors and associate professors. To fulfill this task, the Institute was constantly increasing the number of the instructors involved in post-graduate program. Since 1959, special-purpose post-graduate programs were commonly offered by large higher education establishments of such cities as Moscow, Leningrad, Rostov-on-Don, Sverdlovsk, Novosibirsk and Tomsk. For example, in 1971, there were 119 postgraduates in API (special-purpose post-graduate program – 81 post-graduates, API postgraduate programs – 38 post-graduates), 18 post-graduates successfully defended Candidate's dissertations, 2 post-graduates – Doctor's dissertations. In 1981, the num-ber of post-graduates was 189 (102 - special-purpose post-graduate program, 36 – one-year post-graduate program, 51 – API postgraduate program), 23 faculty members successfully defended Candidate's dissertations, 2– Doctor's dissertations. Overall, during 27 years, 1097 faculty members completed postgraduate course, 456 Candidate's dissertations and 24 Doctor's dissertations were successfully defended.

At this time the construction of the sixth dormitory designated for married students and education building for food production was initiated. A number of new department was established: "Industrial Power Supply", "Building Constructions" (1971 г), "Soviet Legislation and Professional Safety" (1974 г). Department of Chemical Engineering Technology was established in API Affiliated branch in Biysk (1975 г). In 1976, Department of Foundation Engineering, Geo-engineering and Geodetics was established. It was headed by Professor G.I. Shevtsov who still has been occupying this position. Altai Polytechnic Institute named after I.I. Polzunov was the first technical institute and second higher education establishment in the Soviet Union which applied computer technologies in assessing applicant knowledge, skills and abilities in1978. Moscow Institute of Economics and Statistics was the first higher educational establishment in Soviet Union which developed and introduced computer programs (automated control system "Admission") in entrance exams. V.G. Radchenko decided to adopt this practice; however, there were some difficulties to be solved. Firstly, Moscow Institute of Economics and Statistics was 5 times smaller in terms of student number. Secondly, there were no entrance exams in Chemistry. That's why, it can be stated that API became the first higher education institution in the country which introduced automated control system in Mathematics, Physics and Chemistry admission tests. Associate Professor of Chemical Engineering Department (at present - Professor) A.V. Vikharev developed a set of assignments in Chemistry. Since 1984, this system has been also applied in Russian Language and Literature admission tests. Based on the positive experience of API in implementing computer technologies in admission procedures, Ministry of Higher Education Institutions of the USSR recommended all higher education institutions of the country to apply this automated control system. These recommendations were approved by the Committee of the Ministry of Higher Education of the USSR in January 1983. API was stated to be a leading higher education institution in terms of implementing this computer technology. This fact significantly raised the profile and improved the image of the Institute within the whole country.

Due to API faculty members, students and staff, API took the second place in socialist competition of higher professional institutions of the country in 1981. In January 1983, there were 12 thousand students in API, including its affiliated branches in Biysk and Rubtsovsk. On the whole 17, Doctor's Degree and 398 Candidate's Degree holders were involved in teaching process.

After stepping down as a Rector in 1987, V.G. Radchenko was appointed as the Head of Welding Equipment and Technology Department which was renamed Department of Small Business in Welding Engineering in 1997. He held this position until 2011. His high energy, bold and creative thinking, engineering experience and managerial skills helped him to provide the Institute with new facilities, manage the thousands of faculty members, maintain the schedule to expand Institute's premises. As a result, a number of new teaching laboratory buildings, equipped with sophisticated equipment and teaching tools, dormitories and residential building, health and recreation center, roofed sports complex, canteen, health camp were constructed both in Barnaul and API affiliated branches in Biysk and Rubtsovsk (26 different buildings with floor area more than 133000 m2, including Computer Center, Institute TV studio). Under his direction, the Institute expanded by establishing new 15 faculties and 56 departments which trained more than 35000 engineers and offered 26 education pro-grams. Annual total Institute enrollment was 2745 students. In general, under his 27-year supervision and guidance, API trained 35016 qualified engineers, became one of the largest education establishments and scientific centers in Siberia and the whole country, which had significantly contributed to the development of higher professional education and scientific activity of the Academy of Sciences. It can be definitely stated that API has become a real talent foundry in Altai. After stepping down as a Rector, Vasily G. Radchenko defended Doctor's dissertation, became Lenin prize winner and Honored Master of Sciences and Engineering of the USSR, was awarded by four Orders of the Red Banner of Labor and 10 Medals of Honorary Citizen of Barnaul. On May 13, 2012, he died at the age of 86.

New Rector of Altai Polytechnic Institute (one of the largest polytechnic institutes in Siberia) was appointed in 1987. He was a representative of Tomsk scientific school, Doctor of Physics and Mathematics, Professor Vladimir V. Evstigneev[1.,P. 6, 2, P.63,64]. Under his direction, Institute Economic and Social Development Plan for 1990-2000 was adopted in January 1988. During 1988-1990 years, the branches of Internal Combustion Engines Department, Automatic Manufacturing Technique Department and Engineering Automated System Department were established in "Transmash" and Barnaul Radio Manufacturing Plants. Besides, new departments such as Department of Higher Mathematics and Mathmodeling, Department of Physics and Composite Material Technology, Department of Experimental Physics and the Faculty of Automatic Manufacturing Technique were created. The first Humanitarian Faculty aimed at train-ing specialists in humanitarian sciences was established in API in April 1991. At the same year, the Faculty of Foreign Students was created. On September 1, 1991, 12 thousand students were enrolled in API, academic staff numbered 850 full-time instructors (560 Candidate's Degree holders and 29 Doctor's Degree holders).

Two remarkable events highlighted year 1992. First of all, Altai Polytechnic Institute named after I.I. Polzunov celebrated its 50th anniversary. Secondly, in December it was awarded a new status and renamed I.I. Polzunov Altai State Technical University (ASTU). It is worth noting that during this 50-year period, faculty members trained 43691 specialists with higher professional education. It is the contribution that our Institute made to the industrial development of the world power country, the USSR. Vladimir V. Evstigneev paid special attention to the issues of doctoral training. Special program was launched in ASTU in 1992. Altogether, since 1960 the faculty of post-graduate studies has trained 3357 post-graduates and 201 doctoral students; 786 were involved in special-purpose post-graduate programs.

Under 27-year guidance of Vasily G. Radchenko, 361 post-graduates were enrolled in ASTU and 736 were involved in special-purpose post-graduate programs. 455 faculty members defended Candidate dissertations and 25 – Doctoral theses. However, the number of professors, holders of Doctor's Degree, was not so high. In 1987, there were only 18 faculty member who held Doctor's degree. Despite this fact, it can be stated that Vasily G. Radchenko laid the foundation of further Doctoral program by training a great number of Candidate's Degree holders. This is why ASTU was considered to be a talent foundry which trained engineers for national economy of industrial country – the Soviet Union. Rector Vladimir V. Evstigneev picked up the slack on post-graduate programs and increased the number of faculty members holding Doctor's Degree. Therefore, it can be stated that under the supervision of Vladimir V. Evstigneev (1987-1997), the University achieved significant academic results and raised the profile of the University both in Russia and abroad: number of graduated specialists – 13849, 133 Candidate's Degree holders and 47 Doctor's Degree holders.

By September 1, 1998, there were more than 11000 students studying at ASTU including affiliated branches in Biysk and Rubtsovsk, as well as Altai Academy of Economics and Law (8,5 thousand full-time students). Three-tier education system (Bachelor's degree - 4 years, Specialist's degree – 5 years, Master's degree - 6 years) was introduced in the context of 17 education programs and 43 specialties.

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Vice-Rector for Research, Professor A.A. Maksimenko has significantly contributed to developing federal program "Students, Post-Graduates and Young Scientists for Small Science-Charged Business" – "Polzunov's Grants". Due to his insistence and special gift to persuade using numbers and facts, he convinced the members of the Ministry of Education and Science to endorse the initiative of ASTU to launch and coordinate the program "Polzunov's Grants". The program is designated to attract the youth to creation, development and implementation of products or technologies with substantial scientific capacity, which is of great importance in innovative development of Altai region.

During the period from 2007 to 2012 which is characterized by the reform of High School, transition to the multi-level education system, establishment of various federal, local and innovative universities, ASTU was headed by Doctor of Economics, Lev A. Korshunov. Today, the Rector of the largest higher educational institution in Western Siberia is Doctor of Technical Sciences, Professor Alexander A.Sitnikov who carries on the best traditions of engineering school in compliance with new economic requirements.

In conclusion, it is necessary to summarize the results which were achieved by ASTU during its 70-year history. ASTU trained: 101581 specialists, 93192 of which are qualified as engineers; 19237 reserve officers; 201 Doctor's Degree holders and 1172 Candidate's Degree holders. Academic staff numbers 884 instructors, including 86 Doctor's Degree holders and professors, 1 – Lenin Prize winner, 5 Laureates of Presidential Awards, 28 honored workers of science, education, etc., 226 honorary workers of higher professional education of the Russian Federation. Main university buildings, 6 dormitories are located in Barnaul (12,7 hectares). Besides, there are affiliated branches in Biysk (Biysk Technological Institute) and Rubstovsk (Rubstovsk Industrial Institute).

All mentioned achievements definitely contribute to the positive profile of I.I. Polzunov Altai State Technical University and prove its dynamic development and constant quality enhancement.

REFERENCES:

1. GoncharovV.D. ASTU: from Talent Foundry to Cathedral of Science in Altai / V.D. Goncharov; I.I. Polzunov Altai State Technical University. – Barnaul: ASTU Publishing House, 2012. – 277 p.
2. Goncharov V.D. Engineering and Engineering Education in Altai: mono-graph / V.D. Goncharov, E.A. Shaveleva,O.Yu. Sartakova. – Barnaul: ARTIKA, 2011. – 138 p.

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Summary

ABET'S GLOBAL ENGAGEMENT

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This paper will discuss ABET's global activities in detail, with an emphasis on the accreditation of programs outside the US and the Washington Accord, and how these activities contribute to the quality improvement of engineering education around the world, and its impact on engineering education, and the profession.

EUROPEAN PERSPECTIVES ON THE COMPETENCES OF ENGINEERING GRADUATES

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The input-based approach to engineering education, which was the rule during the last century, is being replaced by the ouput-based approach for the design of the programmes as well as for their accreditation. In many institutions, the competences description seems close to a layer over the traditional pedagogical approaches; in particular, the definition and the assessment of the transferable skills are diversely implemented. We present and discuss the state of art in the French engineering education, and a survey to study the impact of these new approaches on the young engineers.

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.

PROGRAM OUTCOMES: THE CORE OF PROGRAM ACCREDITATION

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Association for Evaluation and Accreditation of Engineering Programs (MÜDEK), Turkey
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Program outcomes, which are statements defining the knowledge, skills, and attitudes that students must acquire by the time they graduate, is at the core of accreditation processes. MÜDEK is a non-governmental organization that carries out outcome-based evaluation and accreditation of engineering programs of Turkey. A comparative account, in the light of eleven years of experience, of the first cycle program outcomes of MÜDEK is given.

QUACING APPROACH TO EUR-ACE ACCREDITATION

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QUACING (Italian Agency for Quality Assurance and EUR-ACE accreditation of engineering programmes), Italy

The paper presents the QUACING approach to the EUR-ACE accreditation of Engineering programmes with reference to both accreditation conditions: the consistency of the programme outcomes established by the programmes with the EUR-ACE programme outcomes and a positive assessment of the programme quality.

DEVELOPMENT OF INDEPENDENT PUBLIC ACCREDITATION OF ENGINEERING EDUCATIONAL PROGRAMS IN RUSSIA IN THE 2000-2013 TIMEFRAME

Pokholkov Y.P.
Association for Engineering Education of Russia, National Research Tomsk Polytechnic University

The article presents the current overview of professional-public accreditation of engineering educational programs in the developed countries and describes the accreditation experience of AEER in Russia. Based on the conducted research and the decisions made at public hearings which were held in Saint-Petersburg, the amendments to the Federal Law "On Education", which are aimed at enhancing quality of engineering educational program accreditation in Russia, are proposed.

NEW EDUCATION LEGISLATIVE ACT AS DEVELOPMENT VECTOR OF NON-GOVERNMENTAL-PROFESSIONAL ACCREDITATION IN RUSSIA

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National Center of Non-Governmental-Professional Accreditation

Due to the adoption of new Federal Law "On Education in RF", public-professional accreditation is becoming urgent issue in contemporary education system. The article examines the concepts of public-professional accreditation, international accreditation and joint accreditation. Based on the legislation system, expert organizations and accreditation agencies are classified according to their objectives and activity areas. The ways to develop accreditation network and register of organizations involved in higher education quality assurance have been proposed.

BASIC PRINCIPLES OF PUBLIC PROFESSIONAL ACCREDITATION OF EDUCATIONAL PROGRAMS

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Shaposhnikov S.O.
Saint Petersburg Electrotechnical University "LETI"

The article analyzes basic principle for organizing and carrying out public-professional accreditation of university degree program submitted by technical higher education institutions.

STANDARD INTERVIEW QUESTIONS FOR EDUCATIONAL PROGRAM ACCREDITATION IN THE ASSOCIATION OF ENGINEERING EDUCATION IN RUSSIA

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Siberian Transport University,
Shaposhnikov S.O.
Saint Petersburg Electrotechnical University "LETI",
Yatkina E.Y.
National Research Tomsk Polytechnic University

The authors analyze standard questions asked by AEER experts to students, teachers, employers, faculty authorities while visiting universities to evaluate the achievements of educational program learning outcomes.

CRITERIA FOR PROFESSIONAL AC-CREDITATION OF ENGINEERING PRO-GRAMS OF SECONDARY AND HIGHER VOCATIONAL EDUCATION

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The new draft version of criteria for professional accreditation of engineering programs of secondary and higher vocational education is given in the paper. The criteria meet the requirements of new Federal Law "On Education in the Russian Federation" (№273-FZ) and correspond to the international standards such as EUR-ACE Framework Standards for Accreditation of Engineering Programmes and IEA Graduate Attributes and Professional Competences.

INTERNATIONAL ENGINEERING ALLIANCE CONGRESS (JUNE, 2013 SEOUL, REPUBLIC OF KOREA)

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National Research Tomsk Polytechnic University

Report of Association of Engineering Education in Russia on participation in International Engineering Alliance Congress, 2013. The major achievement of the Association of Engineering Education in (AEER) was its initiation as a provisional member of the International Agreement in professional engineer certification (IPEA). Besides, AEER discussed the formulation of accreditation criteria for programs of secondary vocational education and engineering Bachelor degree.

PUBLIC -PROFESSIONAL ACCREDITATION – EFFECTIVE TOOL IN IMPROVING EDUCATION PROGRAMS EXPERIENCE OF TOMSK POLYTECHNIC UNIVERSITY

Yatkina E.Yu.
National Research Tomsk Polytechnic University

The article presents a comparative eview of expert committee reports which describe the non-governmental-professional accreditation of educational programs in Tomsk Polytechnic University from 2003 to 2012. Previously, the terms "standards, procedures, criteria and requirements", respectively, were used. However, in this article the term "Public -professional accreditation" is officially used as stated in the Federal Law "Education in the Russian Federation" of 2012.

QUALITY ASSURANCE AND QUALITY ENHANCEMENT IN E-LEARNING

Podlesny S.A.
Siberian Federal University

The article examines the issues, challenges and possible solutions related to quality assurance in e-learning applied in engineering education.

PROFESSIONAL AND PUBLIC ACCREDITATION AS AN INTEGRAL PART OF EDUCATION QUALITY IMPROVEMENT

Pecherskaya R.M.
Penza State University

The article outlines the experience of being an expert in professional and public accreditation. Basic elements of accreditation, which effort to improve engineering training quality in contemporary world, are explained.

70-YEAR HISTORY OF ENGINEERING EDUCATION IN ALTAI

Goncharov V.D., Sitnikov A.A. , Sartakova O.Yu., Polzunov I.I.
AltaiStateTechnicalUniversity

The article presents the historical view of engineering education development in Altai. 70-year history of I. I. Polzunov Altai State Technical University is described.

Public-Professional Accreditation of Curricula (Results)

Russian Association of Engineering Education (AEER) has been involved in the development and progression of public-professional accreditation system of engineering and technology programs within Russia during the last 10 years. The following issues were embraced: the study of international experience history and the development of assessment criteria and requirements for engineering and technology programs, pursuant to existing international requirements. Further, Russia, represented by AEER, was admitted to the international Alliance ENA EE (European Network for Accreditation of Engineering Education). AEER was entitled to assigning the international certification label (EUR -AC E label) for accredited programs. In view of this fact, the existing quality assessment system of education programs in Russia has been acknowledged in 14 EU countries, such as Germany, France, Great Britain, Ireland, Portugal, Turkey and others.

At the same time AEER had been taking insistent measures in entering the International Engineering Alliance Washington Accord and in 2007 AEER was included in the Alliance as associated member with Provisional signatory (website WA).

In 2012 (June 14) the International Engineering Alliance Meeting (Interim Meeting 2012, Sidney, Australia) was held, where Russia, represented by AEER, was admitted to Washington Accord (Washington Agreement) as authorized Signatory member (website WA).

Russia became the 15th Signatory- country of the Washington Agreement. This implies that all engineering education programs accredited by AEER are acknowledged by other Signatories as equivalent analogue accredited programs, including such countries as USA , Canada, Great Britain, Japan, Korea, Singapore, Ireland, Australia, South Africa and other countries.

Thus, the quality assessment system for engineering education programs developed by AEER has been acknowledged by the majority of developed countries. It can be stated that a well-developed national public-professional accreditation system for engineering education programs has been established in Russia and AEER accreditation has been internationally accepted.

Based on the results (30.06.2013) 111 EUR-ACE® labels were awarded to 192 accredited education programs from 34 Russian universities; while in Kazakhastan, 34 education programs from 7 universities were awarded EUR-ACE® Label due to international AEER accreditation.

The following Register shows the successfully accredited education programs by AEER.

List of Accredited Programmes, Russian Federation
(as of 30.06.2013)

	Program Code	Qualification	Program Name	Certificate	Accreditation Period
	Altai State Technical University named after I.I. Polzunov				
1.	100400	INT	Electrical Supply	AEER	1997-2002
2.	120100	INT	Mechanical Engineering Technology	AEER	1997-2002
3.	120500	INT	Welding Equipment and Technology	AEER	1997-2002
4.	150900	FCD	Technology, Equipment and Automation of Mechanical Engineering Productions	AEER	2003-2008
	Ivanovo State Power University				
1.	140404	INT	Nuclear Power Plants and Installations	AEER EUR-ACE®	2009-2014
2.	210106	INT	Industrial Electronics	AEER EUR-ACE®	2009-2014
	Irkutsk State Technical University				
1.	130100	INT	Aircraft and Helicopter Construction	AEER	2004-2009
2.	250400	INT	Chemical Engineering of Natural Power Supplies and Carbon-base Materials	AEER	2004-2009
	Kazan National Research Technical University named after A.N. Tupolev				
1.	150600	FCD	Science and technology of new materials	AEER EUR-ACE®	2011-2016
2.	160100	FCD	Aircraft construction and rocket production	AEER EUR-ACE®	2011-2016
3.	230100	FCD	Computer science	AEER EUR-ACE®	2011-2016
	Kazan National Research Technological University				
1.	240100	FCD	Chemical Technology and Biotechnology	AEER	2004-2009
	Krasnoyarsk State Technical University				
1.	200700	INT	Radio Engineering	AEER	1997-2002
2.	220100	INT	Computers, Systems and Networks	AEER	1997-2002
3.	210302	INT	Radio Engineering	AEER	2003-2008
	Komsomolsk-on-Amur State Technical University				
1.	140600	FCD	Electrical Engineering, Electromechanics and Electrical Technology	AEER	2005-2010
2.	140601	INT	Electromechanics	AEER	2005-2010
3.	140604	INT	Electrical Drives and Automated Industrial Sets and Engineering Systems	AEER	2005-2010
	Moscow State Technological University "Stankin"				
1.	120100	INT	Mechanical Engineering Technology	AEER	1993-1998
2.	120200	INT	Metal-cutting Machines and Tools	AEER	1993-1998
3.	120400	INT	Machines and Metal Forming Technology	AEER	1993-1998
4.	210200	INT	Automation of Technological Processes and Manufacturing	AEER	1993-1998
5.	210300	INT	Robots and Robotic Systems	AEER	1993-1998
6.	220300	INT	Automated Production Systems	AEER	1993-1998
	Moscow State Mining University				
1.	090400	INT	Mine and Underground Construction	AEER	1996-2001
2.	090500	INT	Open-pit Mining	AEER	1996-2001
3.	130408	INT	Mine and underground construction	AEER EUR-ACE®	2010-2015
	Moscow State University of Applied Biotechnology				
1.	070200	INT	Low Temperature Physics and Technology	AEER	1996-2001
2.	170600	INT	Food Production Machines and Devices	AEER	1996-2001
3.	210200	INT	Automation of Technological Processes and Manufacturing	AEER	1996-2001
4.	250600	INT	Plastic and Elastoplastic Processing Technology	AEER	1996-2001
5.	270900	INT	Meat and Meat Products Technology	AEER	1996-2001
6.	271100	INT	Milk and Dairy Products Technology	AEER	1996-2001
	Moscow State Institute of Radio Engineering, Electronics and Automation (Technical University)				
1.	210302	INT	Radio Engineering	AEER	2004 -2009
2.	220402	INT	Robots and Robotic Systems	AEER	2005-2010
3.	200203	INT	Optoelectronic Devices and Systems	AEER	2005-2010
4.	220401	INT	Mechatronics	AEER	2005-2010

	Program Code	Qualification	Program Name	Certificate	Accreditation Period
5.	210104	INT	Microelectronics and Solid State Electronics	AEER EUR-ACE®	2005-2015 *
6.	230105	INT	Computer Technology and Automated Systems Software	AEER	2005-2010
7.	230201	INT	Information Systems and Technologies	AEER	2005-2010
8.	230101	INT	Computers, Systems and Networks	AEER EUR-ACE®	2008-2013
9.	210104	INT	Microelectronics and Solid State Electronics	AEER EUR-ACE®	2005-2015 *
10.	200200	FCD	Optical Engineering	AEER EUR-ACE®	2010-2015
11.	210300	FCD	Radio Engineering	AEER EUR-ACE®	2010-2015
			Moscow Institute of Electronic Technology (Technical University)		
1.	210100	FCD	Electronics and Microelectronics	AEER	2003-2008
2.	230100	FCD	Computer Science	AEER	2003-2008
			National Research University of Electronic Technology (MIET)		
1.	140600	FCD	Electrical Engineering, Electromechanics and Electrical Technology	AEER	2005-2010
2.	140602	INT	Electrical and Electronic Machines	AEER EUR-ACE®	2007-2012
3.	140604	INT	Electrical Drives and Automated Industrial Sets and Engineering Systems	AEER EUR-ACE®	2007-2012
4.	140609	INT	Electrical Equipment for Aircraft	AEER EUR-ACE®	2007-2012
5.	140611	INT	Insulators, Cables and Capacitors	AEER EUR-ACE®	2007-2012
6.	140403	INT	Technical Physics of Thermonuclear Reactors and Plasma Installations	AEER EUR-ACE®	2010-2015
			"MATI" -Russian State Technological University		
1.	190300	INT	Aircraft instruments, Measuring and Computing complexes	AEER	1996-2001
2.	110400	INT	Foundry of Ferrous and Non-ferrous Metals	AEER	1996-2001
3.	110500	INT	Metal Science and Thermal Treatment of Metals	AEER	1996-2001
4.	110700	INT	Welding Metallurgy	AEER	1996-2001
			National Research Tomsk Polytechnic University		
1.	071600	INT	High Voltage Engineering and Physics	AEER	1996-2001
2.	080200	INT	Geology and Prospecting of Mineral Resources	AEER	1996-2001
3.	180100	INT	Electromechanics	AEER	1996-2001
4.	200400	INT	Industrial Electronics	AEER	1996-2001
5.	210400	INT	Applied Mathematics	AEER	1996-2001
6.	250900	INT	Chemical Engineering of Modern Energetic Materials	AEER	1999-2004
7.	250800	INT	Chemical Engineering of Refractory Non-Metal and Silicate Materials	AEER	2000-2005
8.	070500	INT	Nuclear Reactors and Power Plants	AEER	2000-2005
9.	220100	INT	Computer Science	AEER	2000-2005
10.	100500	INT	Thermal Power Plants	AEER	2000-2005
11.	101300	INT	Boiler and Reactor Engineering	AEER	2000-2005
12.	230100	FCD	Computer Science	AEER	2003-2008
13.	140600	FCD	Electrical Engineering, Electromechanics and Electrical Technology	AEER	2003-2008
14.	140601	INT	Electromechanics	AEER	2004-2009
15.	140604	INT	Electrical Drives and Automated Industrial Sets and Engineering Systems	AEER	2004-2009
16.	230101	INT	Computers, Systems and Networks	AEER	2004-2009
17.	020804	INT	Geoecology	AEER	2004-2009
18.	130100	FCD	Geology and Prospecting of Mineral Resources	AEER	2005-2010
19.	200106	INT	Measurement Devices and Technologies	AEER EUR-ACE®	2007-2012
20.	200203	INT	Opto-Electronic Equipment and Systems	AEER EUR-ACE®	2007-2012
21.	240304	INT	Chemical Engineering of Refractory Non-Metal and Silicate Materials	AEER EUR-ACE®	2007-2012
22.	240901	INT	Biotechnology	AEER EUR-ACE®	2008-2011

	Program Code	Qualification	Program Name	Certificate	Accreditation Period
23.	140200	FCD	Electrical Power Engineering	AEER EUR-ACE®	2008-2013
24.	150917	SCD	High-technology Physics in Mechanical Engineering	AEER EUR-ACE®	2008-2013
25.	230100	FCD	Computer Science	AEER EUR-ACE®	2008-2013
26.	140600	FCD	Electrical Engineering, Electromechanics and Electrical Technology	AEER EUR-ACE®	2008-2013
27.	140200	SCD	High Voltage Engineering and Physics	AEER EUR-ACE®	2010-2015
28.	130100	SCD	Groundwater Resources Formation and Composition	AEER EUR-ACE®	2010-2015
29.	150900	FCD	Technology, Equipment and Automation of Mechanical Engineering Productions	AEER EUR-ACE®	2011-2016
30.	220301	INT	Automation of Technological Processes and Manufacturing (Gas and Oil field)	AEER EUR-ACE®	2011-2016
31.	210100	SCD	Physical Electronics	AEER EUR-ACE®	2011-2016
32.	140200	SCD	Mode Control of Electric Power Systems	AEER EUR-ACE®	2011-2016
33.	140400	SCD	Electrical Drives and Electrical Drive Control Systems	AEER EUR-ACE®	2011-2016
34.	200100	SCD	Stabilization and Navigation Systems	AEER EUR-ACE®	2011-2016
35.	130500	FCD	Petroleum Engineering	AEER EUR-ACE®	2011-2016
36.	130500	SCD	Geologic-geophysical Problems of Oil and Gas Field Development	AEER EUR-ACE®	2011-2016
37.	140801	INT	Electronics and Automated Physical Installations	AEER EUR-ACE®	2012-2017
38.	240501	INT	Chemical Technology of Modern Power Engineering Materials	AEER EUR-ACE®	2012-2017
39.	140404	INT	Nuclear Power Plants and Installations	AEER EUR-ACE®	2012-2017
40.	200100	SCD	Devices and Methods of Quality Control and Diagnostics	AEER EUR-ACE®	2012-2017
41.	200100	FCD	Measurement Devices and Technologies	AEER EUR-ACE®	2012-2017
42.	200100	FCD	Equipment Engineering	AEER EUR-ACE®	2012-2017
43.	200100	FCD	Devices and Methods of Quality Control and Diagnostics	AEER EUR-ACE®	2012-2017
44.	200100	SCD	Measurement Devices and Technologies of Nondestructive Testing	AEER EUR-ACE®	2012-2017
45.	240100	FCD	Chemical Engineering of Natural Power Supplies and Carbon-base Materials	AEER EUR-ACE®	2012-2017
46.	240100	FCD	Chemical Technology of Organic Substances	AEER EUR-ACE®	2012-2017
47.	240100	FCD	Chemical Technology of Inorganic Substances	AEER EUR-ACE®	2012-2017
48.	240100	FCD	Polymer Processing Technology	AEER EUR-ACE®	2012-2017
49.	240100	FCD	Technology of Refractory Non-Metal and Silicate Materials	AEER EUR-ACE®	2012-2017
50.	240100	SCD	Chemical Engineering of Refractory Non-Metal and Silicate Materials	AEER EUR-ACE®	2012-2017
51.	150100	SCD	Science and Technology of Nanomaterials and Coatings	AEER EUR-ACE®	2012-2017
52.	200400	FCD	Opto-Electronic Equipment and Systems	AEER EUR-ACE®	2012-2017
53.	022000	FCD	Geoecology	AEER EUR-ACE®	2012-2017
54.	201000	FCD	Biotechnical and Medical Devices and Systems	AEER EUR-ACE®	2012-2017
	National Research University «Belgorod State University»				
1.	210400	FCD	Telecommunications	AEER EUR-ACE®	2012-2017

	Program Code	Qualification	Program Name	Certificate	Accreditation Period
2.	210406	INT	Communication Networks and Switching Systems	AEER EUR-ACE®	2012-2017
3.	210602	INT	Nanomaterials	AEER EUR-ACE®	2012-2017
	National University of Science and Technology «MISIS»				
1.	150101	INT	Metallurgy of Ferrous Metals	AEER	2004-2009
2.	150105	INT	Metal Science and Thermal Treatment of Metals	AEER	2004-2009
3.	150601	INT	Science and Technology of New Materials	AEER	2004-2009
4.	150400	FCD	Metallurgy of Ferrous Metals	AEER EUR-ACE®	2011-2016
5.	150400	FCD	Physical Metallurgy of Non-Ferrous, Rare-Earth and Precious Metals	AEER EUR-ACE®	2011-2016
6.	150400	FCD	Functional Materials and Coatings	AEER EUR-ACE®	2011-2016
7.	150400	FCD	Metal Forming	AEER EUR-ACE®	2011-2016
8.	011200	FCD	Physics of Condensed Matter	AEER EUR-ACE®	2012-2017
9.	150100	FCD	Materials Science and Engineering of Functional Materials for Nanoelectronics	AEER EUR-ACE®	2012-2017
10.	150400	FCD	Metallurgy of Non-ferrous, Rare and Precious Metals	AEER EUR-ACE®	2012-2017
11.	151000	FCD	Metallurgical Machines and Equipment	AEER EUR-ACE®	2012-2017
12.	210100	FCD	Semiconductor Devices for Micro- and Nanoelectronics	AEER EUR-ACE®	2012-2017
13.	210100	FCD	Materials and Technologies of Magnetoelectronics	AEER EUR-ACE®	2012-2017
14.	210100	FCD	Micro- and Nanotechnology Processes	AEER EUR-ACE®	2012-2017
15.	220700	FCD	Automated Systems in Manufacturing	AEER EUR-ACE®	2012-2017
16.	230100	FCD	Automated Systems	AEER EUR-ACE®	2012-2017
	Novosibirsk State Technical University				
1.	150501	INT	Materials Science in Mechanical Engineering	AEER EUR-ACE®	2012-2017
	Samara State Aerospace University				
1.	160301	INT	Aircraft Engines and Power Plants	АИОР EUR-ACE®	2008-2013
2.	160802	INT	Spasecraft and Rocket Boosters	АИОР EUR-ACE®	2008-2013
	Saint Petersburg Electrotechnical University "LETI"				
1.	220200	FCD	Automation and Control	AEER	2003-2008
2.	210100	FCD	Electronics and Microelectronics	AEER	2003-2008
3.	230100	FCD	Computer Science	AEER	2003-2008
4.	200300	FCD	Biomedical Engineering	AEER	2003-2008
	Siberian State Aerospace University				
1.	220100	FCD	System Analysis and Control	AEER EUR-ACE®	2011-2016
2.	230100	FCD	Computer Science and Computer Facilities	AEER EUR-ACE®	2011-2016
	Siberian Federal University				
1.	210200	SCD	Microwave Equipment and Antennas	AEER EUR-ACE®	2010-2015
2.	230100	SCD	High-Performance Computing Systems	AEER EUR-ACE®	2010-2015
	Stary Oskol Technological Institute named after A.A. Ugarov (branch of National University of Science and Technology «MISIS»)				
1.	150400	FCD	Metallurgy of Ferrous Metals	AEER EUR-ACE®	2012-2015
	Taganrog Institute of Technology of Southern Federal University				
1.	210100	FCD	Electronics and Microelectronics	AEER	2003-2008
2.	230100	FCD	Computer Science	AEER	2003-2008
3.	230100	FCD	Computer Science	AEER EUR-ACE®	2010-2015

	Program Code	Qualification	Program Name	Certificate	Accreditation Period
4.	220200	FCD	Automation and Control	AEER EUR-ACE®	2010-2015
5.	210100	FCD	Electronics and Microelectronics	AEER EUR-ACE®	2012-2017
6.	200100	FCD	Equipment Engineering	AEER EUR-ACE®	2012-2017
			Tambov State Technical University		
1.	210201	INT	Design and Technology of Radioelectronic Devices	AEER	2006-2011
2.	140211	INT	Electrical Supply	AEER	2006-2011
			Togliatty State University		
1.	140211	INT	Electrical Supply	AEER EUR-ACE®	2009-2014
2.	150202	INT	Industrial Welding Technology and Equipment	AEER EUR-ACE®	2009-2014
3.	151002	INT	Mechanical engineering technology	AEER EUR-ACE®	2009-2014
			Tomsk State University of Control Systems and Radio Electronics		
1.	210100	FCD	Electronics and nanoelectronics	AEER EUR-ACE®	2013-2018
2.	222000	FCD	Innovation	AEER EUR-ACE®	2013-2018
			Trekhgorny Technological Institute		
1.	230101	INT	Computers, Systems and Networks	AEER	2004-2007
			Tyumen State Oil and Gas University		
1.	130501	INT	Design, Construction and Operation of Gas and Oil Pipelines and Storage Facilities	AEER	2006-2011
2.	130503	INT	Development and Exploitation of Oil and Gas Fields	AEER	2006-2011
3.	130504	INT	Oil and Gas Drilling	AEER	2006-2011
4.	190601	INT	Automobiles and Transportation Facilities	AEER	2007-2012
5.	190603	INT	Transport and technological machinery and equipment service (oil and gas production)	AEER	2007-2012
6.	190701	INT	Transportation organization and transport management (automobile transport)	AEER	2007-2012
7.	130602	INT	Oil and Gas Fields Machinery and Equipment	AEER EUR-ACE®	2008-2013
8.	150202	INT	Industrial Welding Technology and Equipment	AEER EUR-ACE®	2008-2011
9.	190205	INT	Lifting, Transportation Means and Road Machines	AEER EUR-ACE®	2008-2013
10.	240401	INT	Chemical Technology of Organic Substances	AEER EUR-ACE®	2009-2014
11.	240403	INT	Chemical Engineering of Natural Power Supplies and Carbon-base Materials	AEER EUR-ACE®	2009-2014
12.	240801	INT	Machines and Apparatus of Chemical Production	AEER EUR-ACE®	2009-2014
13.	280201	INT	Environmental control and rational use of natural resources	AEER EUR-ACE®	2010-2015
14.	280102	INT	Safety of technological processes and productions	AEER EUR-ACE®	2010-2015
15.	120302	INT	Land cadastre	AEER EUR-ACE®	2010-2015
			Ural State Forest Engineering University		
1.	270205	INT	Automobile Roads and Aerodromes	AEER	2006-2011
			Ural State Technical University		
1.	240302	INT	Technology of Electrochemical Productions	AEER EUR-ACE®	2008-2013
			Ufa State Aviation Technical University		
1.	280200	FCD	Environment Protection	AEER	2005-2010
2.	230100	FCD	Computer Science	AEER	2005-2010
3.	150501	INT	Material Science in Mechanical Engineering	AEER	2005-2010
4.	280200	SCD	Environment Protection	AEER EUR-ACE®	2008-2013

	Program Code	Qualification	Program Name	Certificate	Accreditation Period
	Ufa State Petroleum Technological University				
1.	130504	INT	Oil and Gas Drilling	AEER EUR-ACE®	2007-2012
2.	130603	INT	Oil and Gas Processing Equipment	AEER EUR-ACE®	2007-2012
3.	150400	FCD	Processing Machinery and Equipment	AEER EUR-ACE®	2007-2012
4.	240100	FCD	Chemical Engineering and Biotechnology	AEER EUR-ACE®	2008-2013
5.	240403	INT	Chemical Engineering of Natural Power Supplies and Carbon-base Materials	AEER EUR-ACE®	2008-2013
6.	130602	INT	Oil and Gas Fields Machinery and Equipment	AEER EUR-ACE®	2008-2013
7.	130501	INT	Design, Construction and Operation of Gas and Oil Pipelines and Storage Facilities	AEER EUR-ACE®	2009-2014
8.	551830	SCD	Equipment Design Theory for Oil and Gas Processing, Petrochemical and Chemical Production	AEER EUR-ACE®	2010-2015
9.	551831	SCD	Technological Systems and Equipment Reliability	AEER EUR-ACE®	2010-2015
10.	550809	SCD	Chemical Engineering of Fuel and Gas	AEER EUR-ACE®	2010-2015
11.	270100	FCD	Building Construction	AEER EUR-ACE®	2011-2016
12.	550109	SCD	Building Construction	AEER EUR-ACE®	2011-2016
13.	131000	FCD	Petroleum Engineering	AEER EUR-ACE®	2013-2018
14.	151000	FCD	Production Machines and Equipment	AEER EUR-ACE®	2013-2018
	Vladimir State University named after Alexander and Nikolay Stoletovs				
1.	150900	FCD	Technology, Equipment and Automation of Mechanical Engineering Productions	AEER EUR-ACE®	2012-2017
2.	230100	FCD	Computer Science	AEER EUR-ACE®	2012-2017

List of Accredited Programs, Republic of Kazakhstan (as of 31.12.2012)

	D. Serikbayev East Kazakhstan State Technical University (Ust-Kamenogorsk, Republic of Kazakhstan)				
1.	050703	FCD	Information Systems	AEER EUR-ACE®	2011-2016
2.	050713	FCD	Transport, Transport Facilities and Technology	AEER EUR-ACE®	2011-2016
	L.N. Gumilyov Eurasian National University (Astana, Republic of Kazakhstan)				
1.	050702	FCD	Automation and Control	AEER EUR-ACE®	2011-2016
2.	050732	FCD	Standardization, Metrology and Certification	AEER EUR-ACE®	2011-2016
3.	050901	FCD	Organization of Transportation, Traffic and Operation	AEER EUR-ACE®	2011-2016
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