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ACCREDITATION OF ENGINEERING PROGRAMS AND CERTIFICATION OF PROFESSIONAL ENGINEERS IN RUSSIA: A FOCUS ON LIFE-LONG LEARNING

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ACCREDITATION OF ENGINEERING PROGRAMS AND CERTIFICATION OF PROFESSIONAL ENGINEERS IN RUSSIA: A FOCUS ON LIFE-LONG LEARNING

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Socio-economic context, industry transformation, adoption of new technologies and changing trends in the labor market stipulate importance of some competencies. In particular, engineers must supplement technical mastery with communication and business skills, ability to work effectively as an individual and as a member or leader of a team, understanding of ethical, health, and safety issues, as well as social impact of engineering solutions and their professional activity. The importance of life-long learning in engineering profession is also increasing because of a rapidly changing technologies and industry demands. To translate current and perspective needs of industry and to eliminate a mismatch between academic requirements and competencies needed in the workplace national engineering education societies are created. They provide an opportunity for stakeholders to be engaged in educational process and to take active part in the development of standards and frameworks for engineering profession.

One of the most authoritative and recognized non-governmental engineering education society in Russia is the Association for Engineering Education of Russia (AEER) that represents the Russian Federation in the European Network for Accreditation of Engineering Education (ENAEE), is a signatory of APEC Engineer Agreement, a full member of the Washington Accord and a provisional member of the International Professional Engineers Agreement. Among the objectives of the associations are:

- building a system of and conditions for training and maturing of a new generation of highly-educated professionals in engineering capable of maintaining a stable dynamic development of economy and achieving break-through progress in practical fields;
- work towards concentration of the engineering potential of Russia on the break-through technologies and directions that lead Russia out of the social and economic crisis and create conditions for prosperous life of the people of Russia;
- revival and development of engineering schools of Russia, effective use of their potential for building the strategy of sustainable development for the country;
- activities toward joining the efforts of the government, educational institutions, organizations, firms and general public in giving priority to development of engineering education on the basis of progressive pedagogical thinking, use of modern educational technologies, combining the best national traditions and international experience in training engineers;
- improvement of the content of engineering education, attaining its humanization and professionalization, forming a high-level informational culture of the engineering education system, increasing the academic mobility of students to improve the quality of engineering education;
- improvement of the system of retraining and professional development of the engineering education institutions faculty and engineering corps of the country, etc. [1].

To achieve these objectives the AEER uses various mechanisms, namely, non-governmental professional accreditation of educational programs in engineering and technology and professional engineers certification and registration. A review of the literature on engineering education and profession issues, the research and study of the experience of various national

organizations and agencies carrying out the process of program accreditation and engineer certification in different countries, such as the Accreditation Board for Engineering and Technology (ABET) in the USA, Engineers Ireland, Engineers Australia, Engineers Canada, the Engineering Council United Kingdom (ECUK), the German Accreditation Council (ASIIN) as well as the relevant AEER experience have justified that accreditation criteria for educational programs and requirements for professional engineers certification are the main tools to impact the level of engineers' competence. These tools are widely implemented by national engineering societies and accreditation agencies to regulate the engineering profession, to set and maintain internationally recognized standards of professional competence and ethics.

The AEER has been successfully developing an internationally integrated national system for professional accreditation of engineering programs more than 10 years. Program accreditation is defined as "recognition given to a program as meeting applicable criteria as a result of an evaluation process" [2]. It is considered to be an important aspect of quality assurance in engineering and technology education. In contrast to state accreditation run by the federal government professional accreditation is run by professional bodies. It provides evidence of recognition of education quality by professional community and is aimed at improving the quality of education in accordance with industry requirements whereas the main purpose of state accreditation is to conduct comprehensive analysis of academic institutions' activities. Besides, professional program accreditation should allow professional bodies to contribute to the development of engineering and technology programs according their needs. Accreditation provides assurance that college or university programs meet the quality standards established by the profession.

First set of accreditation criteria was developed in 2002 by the AEER experts based on the best traditions of national engineering education and international experience of engineering education quality assurance. In 2013 the AEER criteria were updated and approved by the AEER Accreditation Board. The AEER criteria take into account modern trends in engineering pedagogy, are complied with the Federal State Educational Standards and coherent with the international standards of the European Network for Accreditation of Engineering Education (ENAEE) described in the EUR-ACE Framework Standards for Accreditation of Engineering Programmes [3] and IEA Graduate Attributes and Professional Competencies [4]. By the development of a new set of the accreditation criteria the interests of all stakeholders especially of potential employers were taken into consideration.

The AEER accreditation criteria are grouped into seven sections listed below [5]:

1. Program objectives and learning outcomes.
2. Program content.
3. Education process.
4. Faculty.
5. Professional qualification.
6. Program resources.
7. Graduates.

The criteria provide a common approach to accreditation of engineering and technology educational programs at various levels which stimulates the coherence and continuity of educational programs in Russia. In particular, there are sets of accreditation criteria for technician training, applied bachelor degree, academic bachelor degree, specialist training and master degree programs. The AEER criteria focus on professional training of students

and define graduate competencies relevant for employers and sufficient to make the graduates prepared to enter the profession. Like the EC2000 criteria developed by ABET, the AEER criteria has shifted the emphasis from inputs (what is taught) to student outcomes (what is learned) [6].The criteria are designed to evaluate the quality of engineering graduates and validate that they are prepared for engineering practice as well as for applied, complex and innovative engineering activities at the level meeting the requirements of professional standards, the labor market and international requirements for graduate attributes. The compliance with the criteria shall guarantee the quality of training and promote ongoing improvement of engineering programs.

The AEER criteria are based on program objectives and learning outcomes that outline non-technical (general) and professional competencies to be acquired by students upon completion of an engineering or technology educational program. The outcomes-based accreditation approach used by AEER allows professional bodies to evaluate whether the program graduates have the required competencies to enter the profession or not. 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 institutions and should correspond with the institution mission. Learning outcomes are specified in form of the competencies the graduates have to demonstrate, based on the program objectives and must meet the requirements of employers and other stakeholders. The AEER set common graduate attributes, which correspond to IEA Graduate Attributes and Professional Competencies and meet current needs of the labor market. These attributes are defined in the 5 Criterion and formulated as the knowledge, skills, abilities and competences needed by engineers living and working in innovative-based economic environment. Besides the professional competencies such as application of fundamental knowledge, engineering analysis and design, investigation, engineering practice, specialization and labor market commitment the AEER criteria prescribe requirements for non-technical competencies which program graduates have to demonstrate. Non-technical competencies include management, communication, individual and team work, professional ethics, social responsibility and life-long learning. Recognition of the need for and ability to engage in on-going professional development seem to be extremely important. Continuing professional development is considered a key to improving engineer competence in all the aspects of engineering practice.

To get AEER accreditation, engineering educational programs must go through a complex evaluation process that combines self-study review by the academic institution and program and on-site visit by the AEER evaluators team which includes both engineering academicians and engineers (industry representatives, employers). The key role in the accreditation procedure plays the AEER Accreditation Centre which manages the activity of more than 200 certified evaluators including deans, professors, industry and relevant organizations representatives. Accreditation Centre fulfills the initial analysis of educational programs seeking accreditation, analyzes self-study reports, organizes evaluators' visits to academic institutions, and makes reports on educational program evaluation for the AEER Accreditation Board. During the on-site visit programs are required to show evidence that all the AEER accreditation criteria are met. The aims of the evaluation team at this stage are:

- to give qualitative and quantitative evaluation of the factors that cannot be demonstrated in the self-study report;
- to study documents and reports prepared by the academic institution for program accreditation;
- to make a report for academic institution on its strengths and weaknesses.

The industry representative should pay special attention to the graduates' ability to solve complex engineering problems, to perform their professional functions, to demonstrate skills and competencies necessary to meet the requirements of potential consumers [7]. The educational program audit involves meetings of the evaluation team with academic institution and faculty leaders, the faculty involved in the accredited program implementation, supporting staff, students, graduates, and potential employers. Interviews with students, graduates and potential employers seem to be of highest importance by evaluating the achieved program goals and learning outcomes including the ability to engage in continuous professional development. Evaluation team member can ask students and graduates the following typical interview questions:

- What do you mean in life-long learning?
- What are your plans concerning the professional development?
- Have you finished or are you engaged now in supplementary educational activities (workshops, language courses, trainings, etc.)?
- Are you going to continue your study after finishing the program? Where? When?
- What kinds of CPD are the most effective for engineers?
- What do you think about the mentor's role in the career of young engineer?

The AEER Accreditation Centre is working closely with academic institutions to help them prepare for the engineering educational program accreditation, namely, write self-study report and conduct the on-site visit. Besides it develops training programs for evaluators and organizes workshops gathered experts (representatives from industry, academe and engineering societies) to prepare them for implementation of the AEER accreditation criteria and procedure.

The set and level of competencies of a graduate with a degree in engineering and a professional engineer differ according to the requirements of the Washington Accord and the International Professional Engineers Agreement / APEC Engineer. Litzinger, Lattuca, Hadgraft, and Newstetter (2011) emphasise that development of expertise in engineering demands 10 years of active engagement in a domain and the practice has to be performed with the intention of improving a skill [8].

In countries where the certification of professional engineers is one of the main instruments of engineering profession regulation, a lot of attention is paid to the professional development of young engineers. Nowadays there is no federal law concerning professional qualifications in engineering in Russia. It is an issue for a company to develop and maintain an internal qualification framework. Usually all technicians, technologists and engineers are examined in accordance with corporate criteria periodically. Ranks held and financial rewards are stipulated by the results of the examination. There is no consistency among these regulations throughout the country. The AEER initiated development of a national certification and registration system based on the best international practices in certification of professional engineers and the requirements of the IEA Graduate Attributes and Professional Competencies. The Association involves major stakeholders in discussion of the issue: the State Duma (the national legislative body), the Government of the Russian Federation, the Chamber of Commerce and Industry of the Russian Federation, the Russian Union of Scientific and Public Organizations, engineering universities and companies. In 2008 the AEER received an official proposal to join the APEC Engineer agreement and joined the Agreement in 2009.

In the beginning of the year 2015 168 of engineers are certified with the title APEC Engineer. Among criteria for certification and recertification of professional engineers in Russia is the requirement to develop professional competence during no less than 50 hours per a year. It should be noted that significant part of applications for the professional engineer status were rejected because of lack of evidence of professional development of necessary scope. Furthermore some certified engineers became not eligible for recertification with the same reason.

The following guidelines were elaborated by the AEER upon profound review of international practice of formal, non-formal and informal professional development recognition and consideration of national traditions. The guidelines were approved at the AEER Administrative Board Meeting on the 19th of November, 2013 and are a subject for a further periodic review.

Table 1. AEER guidelines on recognition of professional development of engineers

CPD Activity	Document of Confirmation	Level	Type of Involvement	Amount of Hours
Ph.D. or D.Sc. studies	Diploma of Ph.D. or Sc.D.	Russian and International	Candidate for a degree	Equivalent to the required CPD activities for three years
Educational programmes on professional development	Certificate, diploma / contract	Russian	Learner	Equivalent to indicated academic hours
			Teacher	2 hours for 1 academic hour
		International	Learner	Equivalent to indicated academic hours
			Teacher	3 hours for 1 academic hour
Seminars and training	Certificate, diploma	Russian	Learner	Equivalent to indicated academic hours
			Trainer	2 hours for 1 academic hour
		International	Learner	Equivalent to indicated academic hours
			Trainer	3 hours for 1 academic hour
Conferences	Certificate, diploma	Russian	Participant	10
			Reporter	20
			Member of the board of editors	40
		International	Participant	15
			Reporter	30
			Member of the board of editors	60
Training in other company	Certificate, report of a traineeship supervisor	Russian	Trainee	Up to 100 hours
		International	Trainee	Up to 6 hours per day
Invention	Patent	Russian and International	Author	50
	Patent application	Russian and International	Author	25
Involvement in grant research	Contract	Russian and International	Researcher	Up to 50 hours
Membership in professional societies	Certificate, membership card	Russian and International	Member	Up to 10 hours
On-the-job training (e.g., technology insertion)	Report of the supervisor	Russian and International	Trainee	Up to 50 hours

Writing articles for publication in professional journals	Papers	Russian	Author	20
		International	Author	40
Writing monographs, study books	Papers with the publisher's imprint	Russian	Author	40 hours for 40,000 typographical units
		International	Author	60 hours for 40,000 typographical units
Review of articles, research studies	Review	Russian	Reviewer	3 hours for 40,000 typographical units
		International	Reviewer	4,5 hours for 40,000 typographical units
Review of degree thesis	Review	Russian and International	Reviewer	4 hours for 1 reviewed thesis
Review of study books	Review	Russian and International	Reviewer	4 hours for 40,000 typographical units
Consulting of Bachelor or Master student on a graduation thesis	Letter of confirmation, contract	Russian	Consultant	20 hours for Bachelor thesis 25 hours for Specialist thesis 30 hours for Master thesis
		International	Consultant	30 hours for Bachelor thesis 35 hours for Specialist thesis 40 hours for Master thesis
Involvement in development of a degree programme	Letter of confirmation, contract	Russian and International	Consultant	Up to 10 hours
Supervision of student traineeship	Contract, decree	Russian and International	Supervisor, trainer	1 hour for 1 week per 1 student of 1^{st}-3^{d} year (Bachelor students, Specialist students) 3 hours for 1 week per 1 student of 4^{th}-5^{th} year (Bachelor students, Specialist students), Master student or intern
Elaboration of questions for professional engineers certification examination (for certified engineers only)	Contract	Russian and International	Author	1 hour for 4 questions of written exam
Involvement in examination of professional engineers	Contract	Russian and International	Examiner	Oral examination: 1 hour for 1 interviewee Written examination: 1 hour for 1 test

There is no obvious replication of international experience in CPD hours allocation, however main types of formal, non-formal and informal professional development activities are listed. The main emphasis is put on the outcomes of these activities, so candidates for the professional engineer title or professional engineers wishing to renew their certificates are motivated to be involved in continuous professional development. It is supposed that essential function of a system for certification of professional engineers is the process of professional engineer formation.

Taking into account that professional accreditation of educational programs and certification of professional engineers do not influence the majority of national engineering community, there is a need in a wide-scale tool for disseminating life-long learning principles among students and practicing engineers in Russia. Otherwise it is a challenge for the AEER to promote professional accreditation of educational programs and certification of professional engineers in Russia integrating them into a normative framework provided by the government.

Bibliography

1. Association for Engineering Education of Russia (AEER), official website. Available at: http://aeer.ru/en/goals.htm (accessed 11 March 2015).
2. International Engineering Alliance (IEA), Glossary of Terms. Available at: http://www.washingtonaccord.org/ (accessed 11 March 2015).
3. EUR-ACE Framework Standards. Available at: http://www.enaee.eu/eur-ace-system/eur-ace-framework-standards (accessed 11 March 2015).
4. IEA Graduate Attributes and Professional Competencies. Available at: http://www.washingtonaccord.org/GradProfiles.cfm (accessed 11 March 2015).
5. Chuchalin, A.I. (ed.) (2014) Kriterii i procedura professional'no-obshhestvennoj akkreditacii obrazovatel'nyh programm po tehnicheskim napravlenijam i special'nostjam [Criteria and Procedure for Professional Accreditation of Educational Programs in Engineering and Technology]. Tomsk: TPU Publ., 56 p. (in Russ.).
6. Phillips, W., Peterson, G., Aberle, K. (2000). Quality Assurance for Engineering Education in a Changing World. International Journal of Engineering Education, Vol. 16, No. 2, pp. 97-103.
7. Gerasimov, S.I., Shaposhnikov, S.O., Yatkina, E.Y. (2013). Standard Interview Questions for Educational Program Accreditation in the Association for Engineering Education of Russia. Engineering Education, Vol. 12, pp. 60-65.
8. Litzinger, T. A., Lattuca, L. R., Hadgraft, R. G., & Newstetter, W. C. (2011). Engineering education and the development of expertise. Journal of Engineering Education, 100(1), 123-150.