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Content

The Future Development of APEC in an International Context

(Mr Basil Wakelin, Chair Governing Group IEA)

Introduction

APEC, an organisation to promote cooperation among 21 economies bordering the Pacific Ocean, was formed in 1989 with the mission "to further enhance economic growth and prosperity for the region and to strengthen the Asia-Pacific community".

The APEC Engineer Agreement, now with 15 member economies, commenced formation in 1996 from the APEC Human Resources Development Working Group with the objective of facilitating mobility of engineers between the members. Interestingly the APEC Engineer Manual[1] does not state the purpose of having the agreement although it can be inferred.

The IEA website APEC engineer section describes the objective as *"an agreement in place between a number of APEC economies for the purposes of recognising "substantial equivalence" of professional competence in engineering".*

Today we are going to examine where the APEC Engineer agreement has got to, to investigate where engineering mobility is going and to discuss how APEC Engineer might develop in the future.

The Current Status of APEC engineer

The APEC aims are described thus:

Asia-Pacific Economic Cooperation, or APEC, is the premier forum for facilitating economic growth, cooperation, trade and investment in the Asia-Pacific region.

APEC is the only inter governmental grouping in the world operating on the basis of non-binding commitments, open dialogue and equal respect for the views of all participants. Unlike the WTO or other multilateral trade bodies, APEC has no treaty obligations required of its participants. Decisions made within APEC are reached by consensus and commitments are undertaken on a voluntary basis. [2]

The interesting feature is that the commitments are non binding with no treaty obligations. The prime thrust of APEC is fundamentally economic, concentrating on the promotion of trade.

[1] http://www.ieagreements.com/APEC/Documents/APECEngineerManual.pdf
[2] http://www.apec.org/About-Us/About-APEC.aspx

The APEC Engineer aims as described in APEC Engineer Manual are:

The participants to this Framework intend to facilitate practice by professional engineers by establishing a system of mutual recognition based on confidence in the integrity of the systems of assessment for professional practice within each economy, secured through continuing mutual monitoring, evaluation and verification of those systems.

Two things to notice:
- the key word confidence or trust,
- no mention standards.

The professional standard required to met by engineers under this framework includes:
- A minimum standard of engineering education;
- Gained a minimum of seven years practical experience since graduation;
- Spent at least two years in responsible charge of significant engineering work;
- Maintained their continuing professional development at a satisfactory level;
- Compliance with a code of ethics;
- Accountability for actions.

The framework also specifies the requirement for APEC economies to:
- maintain a register of engineers who meet the standard;
- pursue "*complete or partial exemption from assessment mechanisms operating within the jurisdiction in which an APEC Engineer seeks to become licensed or registered";*
- participate in a coordinating committee comprising all member economies "*to facilitate the maintenance and development of authoritative and reliable decentralised Registers of APEC Engineers, and to promote the acceptance of APEC Engineers in each participating economy as possessing general technical and professional competence that is substantially equivalent to that of professional engineers registered or licensed in that economy*".

There are several important things to note about the APEC Engineer agreement:
- It is an agreement to maintain lists of individual engineers who meet particular requirements.
- It does not recognise whole systems like the Accords.
- There are no legislative or other enforcement mechanisms to ensure meaningful benefits result. The benefits that result can only come from either individual bilateral agreements or self declared statements of benefit but there is no mandatory requirement to give benefits.
- There is no pre or post nominal associated with the status as an APEC Engineer so it remains undifferentiated from other qualifications.
- They are mostly input based criteria.
- There is no mention of the IEA competency standards.

The professional standards are underpinned by a set of educational requirements. These criteria are stated as a degree or equivalent formal education meeting any one a set of standards including:

- an engineering degree delivered and accredited in accordance with the best practice guidelines developed by the Federation of Engineering Institutions of Asia and the Pacific; or
- an engineering degree accredited by an organisation holding full membership of, and operating in accordance with the terms of, the Washington Accord; or
- the 1st Step Examination of the Professional Engineer Examination set by the Institution of Professional Engineers, Japan; or
- the combined Fundamentals of Engineering and Principles and Practices of Engineering examinations set by the United States National Council of Examiners in Engineering and Surveying; or
- an engineering program accredited by a body independent of the education provider, or an examination set by an authorised body within an economy, provided that the accreditation criteria and procedures, or the examination standards, as appropriate, have been submitted by one or more Monitoring Committees to, and endorsed by, the APEC Engineer Coordinating Committee.

These standards are not strictly equivalent and are somewhat different in nature. For example the Washington Accord is a standard applying to a university degree whereas the National Council of Examiners for Engineering and Surveying (NCEES) examination is generally taken post university, and the FEIAP guidelines may or may not be equivalent to the Washington Accord[3]. Thus the base education standards are not necessarily equivalent and may be different from those applied in other key jurisdictions *eg* UPADI or in Europe. The IEA graduate attributes and professional competencies did not exist when APEC Engineer came into existence, which no doubt was partly the cause for the plethora of standards but perhaps the time is right to adopt these standard of educational outcomes and professional competence as the sole standards for APEC Engineer and EMF

Now lets look at where APEC engineer is at today. Whatever the causes the result has been very uncertain benefits and very patchy uptake as the number of APEC engineers in each economy shows.

[3] *The FEIAP guidelines do not appear to be available on the FEIAP website*

Table 1: Number of APEC Engineers

			Total[4]
Australia	400	Malaysia	341
Canada	16	New Zealand	1472
Chinese Taipei	80	Philippines	51
Hong Kong China	54	Russia	30
Indonesia	26	Singapore	12
Japan	2589	Thailand	244
Korea	970	USA.	219
	Total	**6504**	

This table demonstrates that the uptake is not a function of size of the economy or number of engineers in the economy. The No of APEC engineers in New Zealand is about half the total register of Chartered Professional Engineers in the economy and there something to be learned from that,

This great variability and generally low uptake could perhaps indicate that:

- engineers perceive that the agreement is of limited value or
- there is a lack of practical recognition by members and governments; or
- bilateral agreements have dealt with issues between the most significant trading partners and undermined the APEC engineer agreement; or
- it has been inadequately marketed; or
- the processes to achieve APEC Engineer are too difficult; or
- the status as an APEC Engineer is not differentiated so as to add perceived value; or
- other reasons or combination of reasons.

It might therefore be worthwhile to examine the drivers for APEC Engineer to determine the most significant of these and how the environment might be changed.

The Drivers

In general the drivers for any agreement are the benefits that might accrue to all parties. Mostly these are likely to be commercial or economic but personal drivers may also be important.

While all economies could be either economies which supply engineers ie *supply* economies, or *destination* economies there are few economies which are exclusively one or the other although one may be dominant.

From the point of view of the destination economy the commercial drivers for increased mobility of engineers can really only be two fold, namely the acquisition of new expertise or in response to a need for more engineers either temporarily or permanently. These

[4] *As at 2011*

drivers are different from the drivers that may apply to engineering education which recognises that engineers from a foreign economy educated and trained in another jurisdiction develop relationships, knowledge and technical links with that jurisdiction that may foster trade in goods and services.

It is clear however that many destination jurisdictions are very cautious about inward engineering migration and often protective of their own engineers, engineering standards and rights to practice regardless of whatever agreements might be in place. In some jurisdictions a further complicating factor is that engineering activities are controlled or registered at state level rather than at the national level of international agreements.

From the point of view of a providing or supply economy the drivers of engineering mobility may be different and may include poor job prospects in the home economy due a sluggish economy or other causes, or the desire to travel and work in foreign economies to gain wider or different experience or to migrate permanently to new economy for political or other non engineering related reasons. It should be recognised that the drivers are not the same in all economies. For example it is reported that 85% of New Zealanders have a passport whereas about 15 % of Americans do, thus indicating that overseas travel may be more embedded in some cultures than others. Technical isolation of remote or underdeveloped economies has also been a strong driver of travel and qualifications portability in the past though this has undoubtedly reduced with the improved availability of information via the internet.

The personal drivers may also include the desire to gain recognition of having achieved an internationally benchmarked standard of engineering professionalism.

Whatever the personal or jurisdictional drivers of any mutual recognition agreement and regardless of the agreement that is actually in place it is clear that the success of any agreement is based on two things, namely that the agreement is perceived to be of net value[5] to the individual and that the standards and the processes for moderating the agreements are trusted by the parties to the agreements which eases the giving of appropriate benefits.

From the individual perspective what then are the benefits? It would appear that the benefits can only be two fold namely increased professional status and/or simpler and perhaps less costly processes for gaining recognition and/or employment in the destination economies.

What is the world scene?

[5] Net value = the perceived benefits less the perceived difficulty or cost of achieving those benefits

The World Scene

Firstly professional standards and a regulatory framework must exist at a national level before any meaningful dialogue can take place about mutual recognition through bilateral, regional or international agreements. What are the essential elements.

There are many economies which do not have any functional standards or a regulatory framework at professional level *eg* China and many African economies. In these economies the concepts of professionalism are often not well understood. For example, professionalism requires an understanding that judgment in the face of uncertainty is necessarily imprecise and not able to be quantified.

This is perhaps best exemplified by one definition of professionalism**:**

"A profession is an occupational group which specialises in the performance of such highly

developed skills for the meeting of complex human needs that the right use of them is achieved only under the discipline of an ethic developed and enforced by peers and by mastery of a broader contextual knowledge of the human being, society, the natural world, and historical trends".[6]

This definition, which is used in New Zealand, requires in addition to professional judgment, an ethical framework and broad contextual knowledge outside the strict boundaries of engineering. It asserts that engineering is set in a cultural and historical framework which cannot be ignored.

These concepts are included in the IEA professional competence profiles and the APEC Engineer Manual.

In other economies there are very different views as to how professionalism is measured and against what standard. Some important features of the world scene are shown in this slide:

- The development of outcome based competency assessment.
- The plethora of regional groupings *eg* FEANI, UPADI, FEIAP etc
- The overarching role of WFEO
- The development of an international competency agreement.

FEANI[7], UPADI[8] and other regional agreements are driven by common regional interests and mobility requirements. However FEANI recognises a variety of routes and

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[6] Prof Darryl Reeck, an American professor of religious studies

[7] (European Federation of National Engineering Associations). Concerned with the education and training of engineers in 30 countries in Europe (not just the EU)

[8] (Pan American Federation of Engineering Societies). Includes 27 countries from Canada to Argentina including the Caribbean plus Spain as an observer.

educational backgrounds leading to the EurIng title[9], provided only that national monitoring committees have robust processes in place for assessing the adequacy of these. There is however a fundamental difference between APEC Engineer and FEANI jurisdictions. APEC Engineer and the EMF are concerned with the entire *formation* of the engineer from education to independent practice and subscribe to a model where the accredited qualification plus training and experience leads to competency assessment for registration. However in many FEANI member jurisdictions, the title 'Engineer' is granted on award of the educational qualification without additional recognition of the subsequent developmental experience. Thus competence may be measured at different points in the two systems.

Where economies have common borders or are economically interdependent and perceive each other to have similar world views and standards *eg* USA/ Canada or NZ/Australia bilateral free trade and cooperation agreements tend to spring up naturally. Where drivers are unequal or there are language or cultural barriers *eg* USA/Mexico the bilateral arrangements in respect of trade in services are much more cautious. On a larger scale Europe is an example of the efforts to obtain agreements between many partners on educational matters (as typified by the Bologna Agreement and ENAEE in respect of education) and professional portability (as typified by FEANI and EurIng).

One feature common to professional standards systems is that they are all based on achieving a minimum standard of engineering education. It is therefore not surprising that the achievement of an adequate educational base and agreement on these standards was developed before any professional level agreements were possible.

But even here there are considerable differences which are influenced by cultural and other factors such as the nature and maturity of the engineering environment. This is reflected in the differing education requirements of various areas including Europe, FEIAP, and more recently UPADI which is reportedly developing some educational standards.

At the 2012 WFEO meetings a plea was made by one of the vice presidents of WFEO that regions should not rush off to develop new educational standards but rather use those that exist such as the IEA standards which can be modified as may be necessary but have common roots. WFEO is an international, non-governmental organisation representing the engineering profession world wide and, among other things, is concerned with:

- Facilitating communication and cooperation among engineering organisations, governments and those in the UN system.
- Engineers' education, recognition of qualifications and mobility.

[9] See Guide to the FEANI Register 3rd edition

It is perhaps significant that WFEO policy statements make it clear that it does not intend to develop educational and professional standards of its own but to leave that to the national and international bodies representing the profession.

Clearly if there are widely varying educational standards within a non binding professional level agreement it effectively becomes an agreement adopting the lowest educational standard among its members. The benefits resulting from such an agreement will inevitably be much reduced because of this largely unstated, perceived lack of quality by some of its members. It is quite clear that at the core of any successful agreement is a common understanding and trust in the standard and processes to ensure consistent common quality.

There is no schedule of benefits associated with APEC Engineer and the EMF schedule of benefits has proved difficult, uneven and contentious to administer. The current proposals aim to change the EMF from a mobility agreement into a professional competence standards setting and monitoring body which would then depend on the quality of the standard and the rigour of the assessment and monitoring to achieve the required status to gain significant benefits.

So where then, for the APEC Engineer agreement?

The Future Development of APEC Engineer

The rationale for regional agreements is only valid if there are strong regional drivers such as trade or financial reasons for their existence *eg* Europe

Because APEC is an organisation that has no schedule of benefits but rather an agreement to cooperate, any agreement made under its auspices is unlikely to be able to have a schedule of benefits. Therefore it seems appropriate to develop and market APEC Engineer as a bench mark of competence which is monitored robustly and effectively.

This then inevitably raises the questions of what benchmark standard is to be adopted and the process for demonstrating that this has been achieved and maintained. It seems self evident that economies who perceive themselves to have high standards will be unwilling to give any meaningful reciprocal recognition to economies whose standards are still on a developmental path. If that is true then the standard that has to be adopted must be the highest and not the lowest of the economies in the agreement. In saying this it is necessary to differentiate between the standards set by national systems and those achieved by individual engineers. APEC Engineer and EMF currently clearly acknowledge that while national systems my may or may not reach the required standard, individuals from member economies can reach the necessary standard and the economies have in place robust systems for evaluating this on an individual basis. There are two important features that result from this. Firstly the standard must be a single standard defined by characteristics that are assessable . Secondly that a variety of paths to achieve the standards should be allowed for i.e. the concept of equivalence must be incorporated in the rules. For example in terms of education there should be a single standard e.g. an appropriate degree, but alternative educational paths should be allowed which can demonstrate equivalence of education.

Where does the international standard lie? With the increasing mobility of people and expertise, standards will inevitably trend toward a worldwide standard and more universal application so that regional agreements may decrease in favour of a more worldwide focus. This statement is only true however if the leading world economies believe that the standards continues to reflect their values. If not, splintering may result and exclusive clubs of economies may be formed. Hence just as the price of freedom is eternal vigilance the price of unanimity and mutual benefit is the careful guardianship of the standard.

This emphasises the necessity for consistently robust, high quality processes to confirm that the standard is being maintained. Unfortunately the recent economic crisis has again emphasised that the exclusive use of written material to assess quality is not adequate and that there is no substitute for on the spot review and confirmation of documentary evidence. This has always been understood by the educational accords for example. They require an on the ground evaluation of the standards and processes and governance arrangements. By contrast the reliance to date by APEC Engineer and EMF only on documentary assessment has led to some concern that the processes for admission of a signatory and maintenance of the standard are not sufficiently penetrating or robust, and are vulnerable to game playing by selection of the data to be presented.

Summing up it seems clear that the focus of APEC engineer as a standards setting and monitoring body for the assessment of individual professional engineering competency is correct but that certain improvements can be made.

Firstly by adopting clear and unequivocal educational and professional competence standards such as those of the IEA.

Secondly by adopting more rigorous evaluation for admission and review processes.

Thirdly by stronger marketing of this standard to the APEC members and governments so that in the end the ultimate engendering of trust between the AEPC nations my result in significantly enhanced ease of mobility for all our engineers.

The future developments can be summarised as:
1. Clear education and professional competency standards.
2. Rigorous evaluation for admission and review.
3. Simplify the processes for individuals.

4. Increase the trust in the standards and processes.
5. Eventually certification of whole systems rather than individuals.

We still have work to do!

Prospects of Engineering Corpse Certification in Regional Departments of the Russian Chamber of Commerce and Industry

(Mr S.G. Sakun, the First Vice-president of Tomsk Chamber for Commerce and Industry)

The Chamber of Commerce and Industry of the Russian Federation is a non-governmental, noncommercial organization uniting the members for implementation of the tasks on protection of interests of small, medium and large-scale business, and involving industry, internal and foreign trade, agriculture, finance, and a service sector.

The Chamber of Commerce and Industry of the Russian Federation includes:

- 174 territorial commercial and industrial chambers;
- More than 200 unions, associations and other federal business associations and 500 regional business associations, representing the core sectors of the Russian economy;
- About 50 thousand enterprises and organizations of various forms of ownership.

The RF Chamber of Commerce and Industry represents the organized network of chambers in all subjects of the Russian Federation closely cooperating with each other and with world chambers.

The RF Chamber of Commerce and Industry is a member of the World Federation of chambers of commerce, Associations of commercial and industrial chambers of the European economies (EUROCHAMBER), the Council of heads of the CIS member states, Confederations of chambers of commerce and industry of the APR economies, other international and regional organizations.

Today the Chamber of Commerce and Industry of Tomsk represents the harmonious mechanism on creation of favorable conditions for business both in Russia and abroad.

The Chamber has the EUROINFO centre, the subcontracting Centre, the Centre for development of foreign trade activities, and the Centre for business development. The analytical materials of *The First Economic Magazine* published by the Chamber enjoy great popularity.

The regional EUROINFO Correspondence Centre was created in 2008 under the auspices of Tomsk Chamber of Commerce and Industry.

Its main functions and tasks:

- Assistance in business-cooperation development;
- Proposals, needs and business information exchange;
- Assistance in business-missions, exhibitions, seminars, workshops;
- Assistance in business-negotiations between prospective partners;
- Information dissemination related to Russian enterprises.

Besides performing its key function on development of industrial cooperation, the subcontracting centre is responsible for the register of high quality professionals and experts involved in the decision of serious technological problems.

The Chamber actively cooperates with Tomsk universities in the field of professional training for Tomsk business community:

In 2010 the Chamber implemented the pilot project on the development of stimulation of youth innovative business in the Russian Federation together with

- the Federal Agency on Youth Affairs;
- Administration of Tomsk Oblast;
- Tomsk Polytechnic University;
- Tomsk University of Control Systems and Radio Electronics;
- The higher school of the state administration of Moscow State University. Project implementation was aimed at development of youth innovative business (undergraduate and graduate students, post-graduates, etc) and at creation of innovative "growth points" of the regional economy initiated by the young.

Project implementation included the following stages:

1. Training program (December 2009 – March 2010)
2. Probation program (March – August 2010)
3. Establishment of new enterprises (August – September 2010)
4. Presentation of project outcomes (September 2010)

And at each stage there was a thorough selection (we selected 15 participants out of 60 candidates).

The outcomes are as follows:

- the program of training with a package of training materials has been developed and approved;
- the concept has been developed and the system of training is approved;

- all participants (enterprises) are provided with a complete set of necessary documents and formats;
- project participants have developed 10 business plans;
- project participants registered 14 small-scale innovative enterprises;
- project implementation mechanisms have been approved and project outcomes have been presented for discussion in the Ministry of Economic Development and Trade of Russia;
- the received experience is being used for development of youth innovative business in the North Caucasus.

Implementation of this project combined with the conclusions of annual monitoring of business development in Tomsk region performed by Tomsk Chamber of Commerce and Industry following the request of the regional administration, revealed that the level of graduates' practical skills did not win a high appraisal by the local business community.

As a matter of fact, bachelor graduates are just 'future engineers' and to become good engineers, they graduates should not only acquire practical skills but also to confirm their qualifications.

Besides, it triggered our decision to act as a pilot platform of the project developed by the RAEE together with Chamber of Commerce and Industry of the Russian Federation. He key idea of the project is the creation of the network of the centers of international accreditation of technical education and certification of engineering qualifications on the basis of the regional branches of the Chamber of Commerce and Industry of the Russian Federations authorized by the Association of Engineering Education of Russia (RAEE) and the Russian Union of Scientific and Engineering Associations (RUSEA) on application of corresponding international criteria and procedures.

Project tasks:

- Opening of 8 operating centers of accreditation and certification in 8 RF federal districts on the basis of regional chambers of commerce and industry, authorized by RAEE and RUSEA using international criteria and procedures.
- Preparation and formation of groups of experts in the field of public and professional accreditation of technical education and certification of qualifications of professional engineers (not less than 50 in each Center).

Piloting of activities in the following areas:

- international public and professional accreditation of tier educational programs in engineering and technology (not less than 150 programs);
- international certification and registration of professional engineers (not less than 200 experts).
- preparing the draft of the federal law "On regulation of engineering activity in the Russian Federation".

Reserves and resources of RAEE, Chamber of Commerce and Industry of Russia, Tomsk Chamber of Commerce and Industry

The Russian Association for Engineering Education as the member of the European network on accreditation in the field of engineering education (ENAEE) develops criteria and the procedures corresponding to the international standards. It accredited over 200 programs for bachelors, masters and specialists in leading universities of Russia and Kazakhstan, including those assigned EUR-ACE Label. University graduates who have mastered accredited RAEE programs, have the possibility to receive a rank of the European engineer (EurIng), to be registered in FEANI Register, and in the long term to receive the European Professional Engineering Card.

Besides, RAEE is authorized in Russia as the organization having the right to carry out international certification of engineers using standards of APEC Engineer Register. On the basis of the international standards (APEC Engineer Manual and IEA Graduate Attributes and Professional Competencies), RAEE developed the system of certification of qualifications. Using the international standards of the APEC Engineer Register more than 60 professional engineers working at the hi-tech RF enterprises were certified.

Reserves and resources of RAEE, Chamber of Commerce and Industry of Russia, Tomsk Chamber of Commerce and Industry

The Chamber of Commerce and Industry of Russia:

- has skilled personnel, good material base and information resources;
- provides close interaction with the local business community, research and academic complex and authorities.

Reserves and resources of RAEE, Chamber of Commerce and Industry of Russia, Tomsk Chamber of Commerce and Industry

The Chamber of Commerce and Industry of Russia:

- acts as a developed network of chambers in Russia interacting with foreign chambers;
- is the most authoritative and numerous organization having close interaction with associations of federal and regional businesses in all basic sectors of the Russian economy;
- provides active participation in legislative activity;
- has powerful information infrastructure and communication resources;
- employs expert, analytical and educational resources.

The basic stages of project implementation:

1. Creation on the basis of Tomsk Chamber of Commerce and Industry of the first Center of accreditation of technical education and certification of the engineering qualifications authorized by RAEE and RUSEA. Piloting of its work.
2. Creation and piloting of a network of three more centers on the basis of chambers commerce and industry in Privolzhsky, Uralsk and Southern federal districts. (The chamber of Tatarstan has already stated its interest to the issue)
3. Distribution of experience of piloting in other federal districts and opening four more centers.

Expected outcomes and prospects:

- The operating centers of accreditation and certification in each of 8 RF federal districts on the basis of regional chambers of commerce and industry, authorized by RAEE and RUSEA.
- Groups of the prepared experts in the field of public and professional accreditation of technical education and certification of qualifications of professional engineers (not less than 50 in each Center).
- The total number of the accredited educational programs using internationally recognized criteria and procedures will make not less than 150 for 3 years.
- The total number of the experts who will have passed through the system of certification of engineering qualifications will make not less than 200 people for 3 years.
- The draft of the federal law “On regulation of engineering activity in the Russian Federation”.
- The analysis of project outcomes and after the federal law comes into effect, disseminating of the received experience in the subjects of the Russian Federation.

Roles and Objectives of APEC Engineer Register and Current Status of Engineer' Mobility in APEC Economies

(Mr Za-Chieh Moh, Chair APEC Engineer Coordinating Committee)

Introduction

Engineers in the 21st century must be able to cope with a rapid pace of technological change, a highly interconnected world, and complex problems that require multidisciplinary solutions. Meanwhile, it is very important to achieve and maintain a comparable level in quality of engineering services as a whole in the global economy because needs are distributed around the world. It is efficient and socially responsible to leverage or share the manpower, technical strength, and experience in surplus areas with regions that are in need.

From a historical perspective, changes in civilization have greatly affected the way conventional engineers provide their services. Over the last few decades, a typical engineering project has involved two or three engineering disciplines with a broadly similar educational background, working within the same organization and speaking the same language, engaged in solving a well-defined problem. Currently, however, an engineering project in most economies requires engineers with different technical and even non-technical educational backgrounds, from multiple companies or organizations, perhaps in several economies with different languages, engaged on a problem of a conceptual nature for which the input of different interests is needed, and for which achieving a synthesis of different disciplines is necessary. Project schedules are tighter because of advances in information technology, allowing engineers from around the globe to work together via the internet around the clock.

Climate change is increasing the intensity and frequency of catastrophic disasters threatening populations around the earth. Engineers are encountering many challenges that never seen before in human history. On top of that, human rights issues, political interference, and other social economic requirements enlarge the scope and complexity of typical engineering projects. Theories behind design escalate in sophistication as the design specifications and code requirements are updated to improve performance levels. Constraints are tightening in most of the human habitat due to ever-rising concerns and criteria regarding energy saving, environmental conservation, carbon-dioxide reduction, esthetics consideration, health and safety regulation, and sustainable development.

A team approach in sharing knowledge, experience, values, and code of ethics in conducting professional activities can be beneficial in maximizing the contribution of engineering, honoring the significance of the engineering profession, cultivating the younger generation in carrying on this legacy, and encouraging accountability for ensuring the well-being of the society. This team approach can only become real through mutual recognition of engineers regardless of ethnic origin, geographical locations, gender, and ranking. APEC Engineer provides a platform to achieve that goal and a mechanism to solidify the concept of mutual recognition. APEC Engineers aim to increase the welfare of the member economies and people in the Asian Pacific Region; to help engineers grow professionally and develop networks. Through this development, it is hoped that APEC Engineer will become a benchmark of excellence and integrity for industry professionals.

World Engineering Organizations

Including APEC Engineer, there are six international agreements governing mutual recognition of engineering qualifications and professional competence. Three agreements and three accords formulated an International Engineering Alliance, IEA. The three agreements cover recognition at the practicing engineer level i.e. individual people, not qualifications that are seen to meet the benchmark standard. They include the APEC Engineer agreement, the Engineers mobility agreements and the Engineering Technologist Mobility Forum agreement. In each of these agreements, economies who wish to participate may apply for membership (called becoming a signatory), and, if accepted, become members or signatories to the agreement. In broad principle, each economy must meet its own costs, and the body making application must verify that it is the appropriate representative body for that economy. For the APEC Engineer agreement, educational and professional benchmarks for mutual recognition of qualifications and registration have been developed and are incorporated in the APEC Engineer Manual. The agreement has government support in the participating APEC economies.

International professional organizations other than APEC Engineer advocating mutual recognition of engineers and providing bases for engineer mobility include: Engineer Mobility Forum (EMF), ASEAN Engineer, FEANI Engineer, FEIAP Engineer and FIDIC Engineer. The Engineering Mobility Forum agreement is a multi-national agreement between engineering organizations in the member jurisdictions which creates the framework for the establishment of an international standard of competence for professional engineers. EMF was established in 1997 based on the Washington Accord. The initial 11 economies consisted of: United States, United Kingdom, Australia, Canada, New Zealand, Ireland, South Africa, Japan, Malaysia, Korea and Hong Kong. In 2007, for its first expansion, EMF accepted Singapore and Sri Lanka as members, Chinese Taipei and India became full members in 2009. EMF today has a total of 15 member economies.

The ASEAN Federation of Engineering Organization (AFEO) is a non-governmental body. Its members are the engineering institutions and organizations of ASEAN (Association of Southeast Asian Nations) economies with the main objectives of: (i) to promote goodwill and mutual understanding, and (ii) to establish and develop an ASEAN baseline standard for the engineering profession with the objective of facilitating mobility of the engineers within the ASEAN economies.

In 1997, the AFEO Governing Board noted the benchmarking of the APEC Engineer Register and agreed to look into avenue for the AFEO Engineers in APEC. The ASEAN Mutual Recognition Arrangement (MRA) on Engineering Services was signed by the 10 ASEAN member economies in December 2005 and members had since then been working on the implementation of the MRA. The MRA provides for a Professional Engineer in a member economy who met prescribed requirements to be placed on the ASEAN Chartered Professional Engineers Register (ACPER) and accorded the title of ASEAN Chartered Professional Engineer (ACPE).

An ASEAN Chartered Professional Engineer would be eligible to apply to the Professional Regulatory Authority (PRA) of a Host Economy to be registered as a

Registered Foreign Professional Engineer (RFPE). Upon approval, the successful ACPE applicant would be permitted to work as a RFPE, not in independent practice, but in collaboration with designated Professional Engineers in the Host Economy.

As of November 2011, eight ASEAN member economies except Brunei Darussalam and Myanmar have submitted their official notifications to participate in MRA. The total number of ACPE as of 2011 on the ACPE Register is 425 comprising of 97 from Indonesia, 146 from Malaysia, 173 from Singapore and 9 from Vietnam. The registration of RFPE has yet to begin.

The Federation of Engineering Institutes of Asia and the Pacific-FEIAP (formerly FEISEAP) is a non-profit professional organization. Through support from the United Nations Educational, Scientific and Cultural Organization (UNESCO), FEIAP was formed on 6 July 1978 in Chiang Mai, Thailand with 13 member economies. In 2008, FEIAP modified its governing constitutions. Changing member economies to member economies, Chinese Taipei was admitted to be a full member. In the same year, Chinese Taipei was requested by the Governing Council to assist FEIAP in developing guidelines for the accreditation of engineering education (FEIAP Guideline), to raise the level of engineering education in developing economies in the FEIAP region. Among the 13 Member economies in FEIAP, 7 members are also member economies of ASEAN. The question of mutual recognition and mobility of professional engineers is one of the major concern of FEIAP.

The European Federation of National Engineering Associations, (FEANI for the abbreviation of its original name the FEDERATION EUROPEENNE d' ASSOCIATIONS NATIONALES d' INGENIEURS), is made up of 32 European member states' engineering associations. FEANI was founded in 1951 and is headquartered in Brussels, Belgium. FIDIC (the acronym comes from the French version of its name), established in 1913, creates a platform for the global engineering consultant industry to interact, promotes international collaboration between technical services, and advocates for the protection of the natural environment. FIDIC Engineers focuses on commercial activities. The organization has more than 86 multiple national members. Members outside the engineering consultant industry include lawyers, International Development Banks, international organizations, public institutions and enterprise members. The FIDIC has received transnational participation and has become an important information platform for engineering development. The FIDIC is contemplating to establish FIDIC Engineer for the consulting industry.

APEC Engineer History

The APEC leaders' meeting at Osaka in 1995 agreed on the proposal drafted by the Institute of Engineers Australia (now Engineers Australia) and the Institution of Professional Engineers Japan addressing the need for facilitating the mobility of qualified persons among the member economies. Consistent with the Osaka Action Agenda, the meeting of the APEC Human Resources Division (HRD) Ministers from 18 member economies in Manila in January 1996 supported the acceleration and expansion of project initiatives establishing the mutual recognition of skills and qualifications. The APEC HRD Working Group, which met in Wellington, New Zealand in January 1996, agreed to the initiation of the project in Australia, focusing on professional engineering accreditation, recognition and development. During the First Steering Committee Meeting held in May 1996 in Sydney, Australia, a consensus was reached to proceed with a comprehensive survey of professional institutions and societies, registration of professional engineers, and status of engineering education and development. The results of the survey formed a framework for best practices in professional engineering accreditation, recognition, and development. In November 1998, the Second Steering Committee meeting was held in Sydney, Australia. Each economy submitted its assessment report in accordance with a draft assessment requirement. An Expert Advisory Group, a consultant, and the sponsorship of the Commonwealth of Australia provided valuable comments after review of the assessment statement. The group also proposed the launch of the APEC Engineer Coordinating Committee, AECC, and nominated Australia, Canada, and Japan as members of the Workshop for Licensing and Regulatory Authorities in July 1999.

Initiated in November 1999, the APEC Engineer agreement has become the oldest agreement recognizing that a person in one economy who has reached the international standard of competence should only be minimally assessed (primarily for local knowledge) prior to obtaining registration in another economy that is a party to the agreement. The representative organization in each economy creates a "register" of those engineers wishing to be recognized as meeting the generic international standard. Other member economies should give credit when an engineer listed on the register seeks to have his or her competence recognized. The Agreement is largely administered by engineering bodies, but there can be government involvement. Also, any substantive changes need to be signed off at the governmental APEC Agreement level.

The APEC Engineer Coordinating Committee established the Constitution of the APEC Engineer Agreement and the APEC Engineer Manual. The first edition of the APEC Engineer Manual set out the methodology for assessing the academic and professional experience of engineers against a standard established by the economies in order to determine substantial equivalence for professional engineers. The initial operation of authorized APEC Engineer Registers by the eight founding economies commenced on 1 November 2000, and was based on “The APEC Engineer Manual: The Identification of Substantial Equivalence” (November 2000). Thirteen economies (more than 60% of the 21 APEC economies) participated in the sixth APEC Engineer Coordinating Committee Meeting, held in Washington, D.C. in June 2007.

Several subsequent revisions to the APEC Engineer Manual have been made, to fine-tune the model agreement and to facilitate the mobility of engineers. The first revision of the APEC Engineer Manual was agreed upon at the Coordinating Committee Meeting held in 2001 in Kuala Lumpur. The second revision was agreed to at the Coordinating Committee Meeting held in 2003 in Rotorua, New Zealand. It made the listing of disciplines optional, allowed monitoring visits to be done on-line (followed by on-site monitoring visits if needed) and provided a dispute resolution procedure whereby dissenting members would submit a minority report if a unanimous decision by the review team was not reached.

Under the supervision of the APEC Engineer Coordinating Committee, the Manual has undergone continuous improvements and refinements at the subsequent biennial APEC Engineer Coordinating Committee Meetings. Today, the seventh edition of the Manual continues to facilitate the mobility of engineers between economies and to encourage the participation of more economies in the region, with the aim of promoting the overall mobility of engineers. The APEC Engineer Coordinating Committee promotes the recognition of registered APEC Engineers by trade agreement negotiators through mutual recognition arrangements in the region.

Monitoring Committees are independent authorized bodies established in each economy to oversee development and maintenance of a register of APEC Engineers. According to the APEC Engineers Manual, the Coordinating Committee is responsible for coordinating and overseeing the activities of each economy; its members are the Monitoring Committees of each of the APEC economies. Therefore, the members of the Coordinating Committee are the Chairs (or designated persons) of the Monitoring Committees in each economy.

At the present time, there are 14 full-member economies within the APEC Engineer Registers. The current officers of the APEC Engineer Registers include the Chair, Deputy Chair and Secretariat. The Chair and Deputy Chair of the APEC Engineer Coordinating Committee were elected at the June 2011 Taipei meeting. Through a contractual agreement, the Institution of Professional Engineers New Zealand (IPENZ) provides the Secretariat for the APEC Engineer Coordinating Committee. Two other international agreements and three educational accords also served by the same secretariat, they are: EMF International Engineer Register, ETMF International Engineering Technologist Register, the Washington Accord for Engineers, the Sydney Accord for Engineering Technologists and the Dublin Accord for Technicians.

Current Status of APEC Engineers

Each economy of the APEC Engineer Agreement has committed that the extra assessment required to be included on the local professional engineering register will be minimized for those registered under the APEC Engineer Agreement. All economies are obligated to submit a written report indicating their current status and any mutual agreements with other economies for a two-year period. As of September 2011, there are 14 economies and many observers partaking in APEC Engineer. The official name, representative, and year of joining the APEC Engineer Register (AER) of each economy are listed in Table 1:

Table 1. The official name and representative of each economy maintaining APEC Engineer Register

Economy	**Represented by**	**Year**
Australia	Engineers Australia	2000
Canada	Engineers Canada	2000
Hong Kong, China	Hong Kong Institution of Engineers	2000
Indonesia	Persatuan Insinyur Indonesia	2001
Japan	Institution of Professional Engineers Japan	2000
Korea	Korean Professional Engineers Association	2000
Malaysia	Institution of Engineers Malaysia	2000
New Zealand	Institution of Professional Engineers NZ	2000
Philippines	Philippine Technological Council	2003
Russia	Russian Association for Engineering Education	2010
Singapore	Institution of Engineers Singapore	2005
Chinese Taipei	Chinese Institute of Engineers	2005
Thailand	Council of Engineers Thailand	2003
United States	National Council of Examiners for Engineering and Surveying	2001

Members of the Agreement have full rights of participation in the Agreement; each operates a national section of the APEC Engineer Register; and registrants of these national sections may receive credit when seeking registration or licensure in the jurisdiction of another economy.

Since the establishment, the Coordinating Committee and the APEC Engineer General Assembly have held meetings regularly. To increase mutual understanding and cooperation, an interim workshop is held between the Coordinating Committee Meetings. The dates and locations of various meetings and workshops are listed in Table 2.

Table 2. History of APEC Coordinating Committee Meetings and Workshops

Date	**Type**	**Location**
November 1999	Inaugural Meeting of the Coordinating Committee	Sydney, Australia
June 2000	Workshop	Vancouver, Canada
12 June 2003	Workshop	Rotorua, New Zealand
17 June 2005	APEC Human Resources Development Working Group	Hong Kong, China
27-30 June 2006	IEM Workshop	Dublin, Ireland
19-22 June 2007	Coordinating Committee Meeting	Washington, D.C., U.S.
23 June 2008	IEA Workshops	Singapore
19 June 2009	APEC Engineer General Meeting	Kyoto, Japan
21 January 2010	Governing Group teleconference	N/A
21-23 June 2010	IEA Workshops	Ottawa, Canada
1 February 2011	Governing Group teleconference	N/A
17 June 2011	APEC Engineer General Meeting	Taipei, Chinese Taipei
22-23 May 2012	International Seminar	Kazan, Russia
June 2012	IEA Workshops	Sydney, Australia

Based on the Review Report submitted by the 14 economies in June 2011, there are a total of 4,738 APEC Engineers registered in 24 different fields of practice. The detailed numbers of APEC Engineers and their specialties within each economy are shown in Table 3. A small number of agreements and memoranda for mutual recognition and practice have been signed between economies as shown in Table 4. It is apparent that while several ongoing memoranda of understanding have been signed, there is still no official agreement on mutual recognition signed between the Economies.

Pending Issues

Since every economy in the APEC has a different system of classification for the Professional Engineer (PE) license, it is a nearly impossible task to unify the titles regulating areas of practice. The names of the various disciplines were primarily proposed by individual Monitoring Committees with supporting explanations of the relevant academic training and practical experience. Also, different economies have different approaches to what the APEC Engineer designation is and how it can be used. Details of equivalence between different disciplines, scopes of practice, or even simple nomenclature will have to be discussed during bilateral or multilateral discussions on mobility.

The engineering profession in each economy is regulated by different authorities. In majority of the economies in the APEC region, there is one single regulatory body responsible for issuing practising licenses. In a few economies, the authority of licenses is chartered to a professional institution. The engineering professions in Canada and the U.S. are regulated by legislation in each province and states, respectively. Engineers Canada and the National Council of Examiners for Engineering and Surveying in the U.S. will have to reach a unifying domestic consensus on reciprocity within their own economies before their professional engineers can be mobilized to other economies as a whole.

Other challenges and difficulties in promoting engineers' mobility include, but are not limited to: the mindset in the traditional engineering community, legal issues, political issues, concerns related to open markets, and leadership. The impact of industry globalization and foreign competition has not been properly assessed, resulting in overreaction and inadequate policies for domestic protection. Cross-cultural collaboration and communication skills, multinational team management skills, the ability to overcome the social challenges of geographically distributed teams, and familiarity with the construction materials, standards, and methods of foreign economies are vital for modern construction professionals. However, the traditional training of engineers and construction managers does not equip local engineers to successfully deal with such issues. The education of governing officials and the engineering community is the key to change.

In terms of the legal issues relating to the globalization of engineering and construction, institutional arbitration has become significantly less commercially viable in the international consulting industry as a primary means of dispute resolution because of the uniqueness of the engineering procurement process. The need for an efficient dispute resolution process is rising because of the globalization of engineering consulting. Recent developments in the standard contract forms of the International Federation of Consulting Engineers (FIDIC) include the establishment of the Dispute Adjudication Board (DAB) to address the fundamental need for a commercially viable means of construction dispute adjudication.

Many issues that pertain to small, developing economies are not concerns for those economies with a legacy of developed educational systems. Several economies face more challenging management-related issues, requiring engineers who wish to work there to be equipped with additional skills to cope with globalization challenges. Historically, standardization is closely related to similarity between markets with respect to regulatory environments, technological intensity and growth, customs and traditions, customer characteristics, a project's stage in its life cycle, and competitive intensity. Also, the topic of culture has received increasing attention in management literature in general in past decades and in project management literature in particular in the last few years.

The leaders of the economies strive to overcome the difficulties mentioned above. It is believed that with an open and cooperative spirit, especially with the help and full support of the APEC HRD Ministers, none of the issues will prevent the attainment of the overall goals of APEC Engineer.

Proposed Tactics to Increase Participation and Mobility

There are 21 economies within the APEC family. Several member economies have not yet established their presence in or involvement with APEC Engineer. Some actions could be taken to increase the number of economies participating. For example, a translation of the APEC Engineer Manual into Spanish might improve South American participation. Looking to the future, APEC Engineer has every intention of extending welcome to any non-member economies to join, if more resources and directions are provided. The APEC Economic Leaders can engage APEC Engineer economies with broader involvement for obtaining resources and experience. Today, APEC Engineers work closely with the Federation of Engineering Institutions of Asia and the Pacific (FEIAP). The two organizations share common values and vision, and have overlaps in leadership, allowing the continuous interchange of ideas. In 2010-2011, FEIAP requested the Chinese Institute of Engineers of Chinese Taipei and the Institute of Engineering Education, Taiwan (IEET) to develop an accreditation guideline for higher education. Myanmar and Papua New Guinea volunteered to test the protocol of the new education standards among FEIAP members.

Recognizing the differing levels of development among economies, the APEC previously set two broad objectives. As of 2010, the first goal of free and open trade in industrialized economies has been accomplished. APEC Engineers will no doubt be a key contributor in advancing the second objective of the APEC of promoting free and open trade in developing economies by 2020. APEC Engineers in the registers within APEC economies have been benchmarked to be substantially equivalent to a standard, as stated in APEC Engineer Manual. The APEC Economic Leaders should take proactive steps, providing analytical, rigor and academic strength to the process and helping to promote dialogue between government policymakers and the academic community.

Finally, to simplify the mutual recognition arrangements, the feasibility of recognizing the APEC engineer certificate as the only requirement listed in the trade agreements for the practice of professional engineering services should be rigorously reviewed and studied. APEC Economic Leaders can allocate funding to the proper organizations to analyze the advantages and disadvantages of this action. The "ASEAN MRA on Engineering Services" amongst the ten ASEAN economies provides a potential model for future actions. The applicability and related effects of adopting the ASEAN MRA model in APEC Engineers are worthy of investigation. This could provide a good probability of success by building on an existing foundation, and also ensure high effectiveness in promotion the effort through the involvement of the government authorities.

Summary

The engineering community needs to proactively facilitate the mobility of engineers between economies. It would also be beneficial to encourage more economies in the region to participate, with the aim of promoting the mobility of engineers. In many economies, involvement is a governmental issue and may be beyond the terms of reference of the monitoring committees. However, the mobility of engineers could further be promoted with the support of APEC Economic Leaders by recognizing the APEC Engineers Registers in bilateral or multilateral trade agreements between APEC economies. All monitoring committees have to consult their own government's views about the matter beforehand. The APEC Economic Leaders should closely monitor progress in this area within their own economies. The missions and objectives of APEC Engineers Register are straightforward and clear. Development of the APEC region as a whole will be different once receiving significant contributions from fellow member economies.

Acknowledgement

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Table 3. Number of APEC Engineers Registered as of June 2011

Economy \ Discipline	Aerospace	Bio	Building	Building Services	Chemical	Civil	Electrical	Electronics	Engineering Physics	Environmental	Fire	Geotechnical	Hydraulic	Industrial	Information	Instrumental Control	Mechanical	Metallurgical	Mining	Petroleum	Sanitary	Structural	Telecommunication	Transportation	Total
Australia	**1**				**12**	**217**	**58**			**5**							**67**					**40**			400
Canada					**1**	**6**																**9**			16
Hong Kong, China			**2**	**7**		**14**	**6**			**2**	**1**	**5**		**1**			**5**					**11**			54
Indonesia						**7**	**7**		**4**								**8**								26
Japan		**3**			**26**	**153 8**	**52**			**32**		**6**		**39**	**11**		**64**		**1**			**817**			2589
Korea		**22**		**63**	**14**	**260**	**35**			**20**	**14**	**2**		**14**	**34**		**31**		**7**	**2**		**40**		**4**	970
Malaysia	**1**			**1**	**11**	**185**	**73**			**2**		**11**				**2**	**49**	**1**		**1**		**2**	**1**		341
New Zealand																									1472
Philippines					**1**	**10**	**9**	**5**				**2**					**10**	**2**	**7**		**5**				51
Russia																									30
Singapore							**2**										**3**					**7**			12
Chinese Taipei						**35**	**8**			**15**		**8**	**2**									**12**			80
Thailand						**132**	**46**							**6**			**58**		**2**						244
U. S. A.																									334
Total	**2**	**25**	**2**	**71**	**65**	**240 4**	**296**	**5**	**4**	**76**	**15**	**35**	**2**	**60**	**45**	**2**	**295**	**3**	**17**	**3**	**5**	**938**	**1**	**4**	**4738**

Table 4. MRA or MOU signed

	Australia	Canada	Chinese Taipei	Hong Kong China	Indonesia	Japan	Korea	Malaysia	New Zealand	Philippines	Russia	Singapore	Thailand	U.S.A.
Australia														
Canada	○													
Chinese Taipei														
Hong Kong China		●												
Indonesia	○													
Japan	◎													
Korea	○		○											
Malaysia	◎		○											
New Zealand														
Philippines						◎								
Russia														
Singapore														
Thailand														
U.S.A.														

◎ Signed agreement ○ Ongoing MOU

● The Mutual Recognition Agreement between the HKIE and Engineers Canada was dealt with under a framework other than APEC Engineer.

Others: Canada and Ireland (Feb. 2009), Korea and U.S. (ongoing)

National system of certification of professional qualifications on the basis of international standards

(Prof P.S .Chubik, Prof A.I. Chuchalin, Mr A.V. Zamyatin, Mr A.S. Fadeev)

Introduction

Russian leaders pay special attention to development of the national engineering cohort which is regarded as the key player in economy modernization processes. Improvement of professional competence of RF engineers capable of responding to present-day challenges is one of the most crucial national ideas requiring urgent strategic steps.

In developed economies such as the USA, Great Britain, Japan, etc., the national economy is provided with highly professional specialists due to efficient systems of licensing and/or certification and registration of professional engineers. As a rule, such systems make the second step of technical specialists' quality assurance. The first step includes public and professional accreditation of engineering educational programs confirming the quality of basic engineering education; it being known that both the first and the second steps of specialists' training quality in engineering and technology are usually performed by non-governmental public and professional organizations using certain criteria and procedures.

Organizational and legal status of such organizations and other important questions of technical education and engineering activity are regulated on a historically developed standard legal base, the status of elite (professional) engineering community is confirmed by existing laws.

Considering the importance of qualified engineers for sustainable development, there is also the international standardized legal base defining the criteria and procedures of mutual recognition of engineers and ensuring their high professionalism. Such standards are developed, discussed and coordinated by the Federation of National Engineering Associations (Fédération Européenne d'Associations Nationales d'Ingénieurs, FEANI) in Europe, APEC Engineer Register in Asian-Pacific region, Engineers Mobility Forum (EMF) on the global level.

Let us consider the basic recognition criteria of engineering qualifications offered by these international organizations.

FEANI Register. In Europe certification and registration of professional engineers is carried out by the Federation of National Engineering Associations (FEANI). FEANI includes 80 engineering organizations which represent the interests of 3.5 million engineers in Europe. Since 2008, Russia is a full FEANI member represented by the Russian Union of Scientific and Engineering Associations (RUSEA) which serves as a base for the Russian branch of FEANI national monitoring committee. FEANI is officially recognized by the European Commission as an upholder of professional interests of engineering community in Europe; it has a consultative status in UNESCO, the UN and EC organizations on industrial development.

FEANI promotes mutual recognition of engineering qualifications in Europe, and strengthens its position, role and responsibility of engineers in the society by awarding the European engineer (EurIng) title. EurIng holders are included in the FEANI Register which totals ten thousand professional engineers. To be included in the FEANI Register and to become highly competitive on the European labor market, an engineer should meet certain requirements.

One of the basic criteria is engineering professional preparedness and compliance with existing standards and requirements. In accordance with *FEANI Formation* standards, the minimum component of education received in FEANI member economies is defined as (B+3U), and the minimum component of engineering practical experience as 2E. The basic formula describing FEANI requirements to engineering professional preparedness, can be presented in the following way:

$$C = B+3U+2U+2E,$$

or

$$C = B+3U+2T+2E,$$

or

$$C = B+3U+2E+2E,$$

where C is duration of training, B is the period of secondary education, U - one year of training at university, T - one year of engineering practice, E - one year of engineering activity.

FEANI criteria include the following requirements to professional engineers:

- understanding of essence of engineering profession and the duty to serve the society, profession and to preserve the environment by observing the code of FEANI professional conduct;
- high level of understanding of engineering principles based on mathematics and other scientific disciplines related to the field of engineering specialization;
- general knowledge of engineering activity and state-of-the-art industries, including use of materials, components and software;
- ability to apply necessary theoretical and practical methods to analysis of engineering problems and their solution;
- ability to use state-of-the-art and perspective technologies in the area of engineering competence;

- knowledge of engineering economy, methods of quality assurance, ability to use the technical information and statistics;
- ability to work in interdisciplinary project teams;
- soft and leadership skills, including administrative, technical, and financial aspects;
- good communicative skills and maintenance of the necessary level of the competence by means of continuous professional development (CPD);
- knowledge of standards and rules corresponding to the area of specialization, ability to meet new technological changes and creativity;
- good command of European languages, sufficient for professional communication in the European context.

In 2007 – 2008, FEANI in partnership with EUROCADRES (the European professional organization) developed the System of registration of professional engineers in Europe awarding the European Professional Engineering Card.

Engineers Mobility Forum. The Engineers Mobility Forum (EMF) is the international organization that has been providing global professional mobility of practicing engineers since 1997. It unites national associations of the USA, Canada, Great Britain, Australia, Japan and other economies in the field of certification and registration of professional engineers. EMF members have coordinated requirements to professional engineers and defined the international standards of assignment of ranks, granting to professionals the right to equivalent status in EMF member economies that provides their international professional mobility.

EMF has founded the International Register of professional engineers which includes EMF Registered International Professional Engineers (IPE) who have positive assessment of the EMF Monitoring Committee and meet the criteria of EMF Agreement and Memorandum of Understanding signed by EMF member economies.

The registration criteria for EMF international professional engineer include the following:

- a university degree in engineering programs accredited by the Washington Accord criteria;
- ability to independent professional engineering activity;
- practical experience not less than 7 years, including 2 years of work in supervising capacity at performance of an important engineering project;
- continuous professional improvement;
- observation of EMF engineer professional code.

APEC Engineer Register. The APEC Engineer Register is created in the context of Asia-Pacific Economic Cooperation. APEC was established in 1989 for development of economy, trade and investments in the Asian-Pacific region. APEC includes 21 economies, among them the USA, Canada, China, Japan, Australia, New Zealand, Russia, etc.

Registration of engineers in the APEC Engineer Register implies recognition of their professional status and increase in competitiveness on the international labor market in APEC member economies. The Russian monitoring committee of APEC Engineers was established on the basis of RUSEA.

For registration as APEC Engineer, it is necessary to meet the following requirements confirmed by the International Coordinating Committee of APEC engineers:

- graduation from the university with the accredited engineering program;
- recognition in the economy of residence with the right to conduct independent professional engineering activity;
- not less than 7 years of practical engineering experience after graduation;
- not less than 2 years of experience in supervising capacity at performance of an important engineering project;
- continuous professional improvement;
- observance of professional engineering code.

The standard approved by the Russian monitoring committee of APEC Engineers provides the following universal and professional competence coordinated with the requirements of the International Engineering Alliance (IEA) stated in *Graduate Attributes and Professional Competences*:

- sensible application of universal knowledge and readiness to apply it in practical engineering activity in the international professional mobility context;
- sensible application of local knowledge and readiness to apply it in practical engineering activity in the international professional mobility context;
- analysis of engineering problems (readiness for goal-setting, research and analysis of complex engineering problems);
- design of engineering decisions (readiness for designing and working out of decisions of complex engineering problems);
- estimation of engineering activity (readiness to estimate the importance of complex engineering activity outcomes);
- social responsibility (readiness to show high responsibility for social, cultural and environmental consequences of complex engineering activity in a sustainable development context);
- observance of the legislation and principles of law (readiness to observe all legal norms and requirements, including those regarding health protection and safety while conducting engineering activity);
- engineering ethics (readiness to conduct engineering activity in compliance with established ethical standards);

- organization and management of engineering activity (readiness for partial or full management of one or several kinds of complex engineering activity);
- communication (readiness for clear and open dialogue with other participants of complex engineering activity);
- life-long training (readiness for continuous improvement of professional skills necessary for competence development);
- taking engineering decisions (readiness for taking alternative engineering decisions if required by common sense in difficult situations of inconsistent requirements or lack of technical information);
- responsibility for engineering decisions (readiness to bear partial or full responsibility for decision-making while conducting complex engineering activity).

Russia is on the verge of creating efficient mechanisms of engineering graduates' quality assurance in Russia in the conditions of economy globalization. Today specialists' training in engineering and technology is carried out by 555 Russian universities, including 442 state and 113 non-state higher education institutions. The engineering students' cohort makes about 30 % of the total number of students, which is over 1.5 million. It is noteworthy that the USA, the economy comparable to Russia in territory and population but excelling the Russian Federation in technological development in many areas, has less technical graduates. The number of RF engineering graduates almost surpasses the US statistics as much as 1.5 times. However, two thirds of Russian graduates do not work in engineering, since the quality of their education and readiness for real work, according to employers, leaves much to be desired. At the same time, the real economy sector is experiencing severe shortage of qualified engineers capable of breakthrough changes in major industries.

In the USA, the National Council of Examiners for Engineering and Surveying (NCEES) is engaged in state regulation of engineering profession. The basic function of the NCEES is the definition and unification of examinations procedures for experts and provision of the regulatory support for the boards of directors in every state and coordination of their work.

The applicants, who have successfully passed examinations, obtain the license for the right of carrying out independent engineering activity. Licensing is obligatory for the engineers whose work involves rendering of services to the public. If, for example, the position is connected with engineering activity for the benefit of the private company, a specialist can perform his/her functions without a license. But even in these cases professional engineers prefer to have it due to a great number of advantages, either better career prospects or a higher salary. All in all, in the USA there are over 470 thousand licensed engineers, which makes about one third of the total number of specialists.

As for Russia, however, there are about 5 million of technical university graduates occupying various engineering positions. About 10 % of the total number of such specialists, i.e. about 500 thousand people are highly qualified professionals employed mainly by high-end technology industries thus providing the most appreciable influence on Russia's technological development. Considering the experience of foreign economies, including the USA, about thirty per cent out of this number (i.e. 100-150 thousand engineers) are capable of meeting the criteria and procedure requirements of the system of professional certification and being regarded as top national technical experts.

One of the variants of building the national system of certification and registration of top quality engineers is provided by the National Committee on Regulation of Engineering Activity (Figure 1).

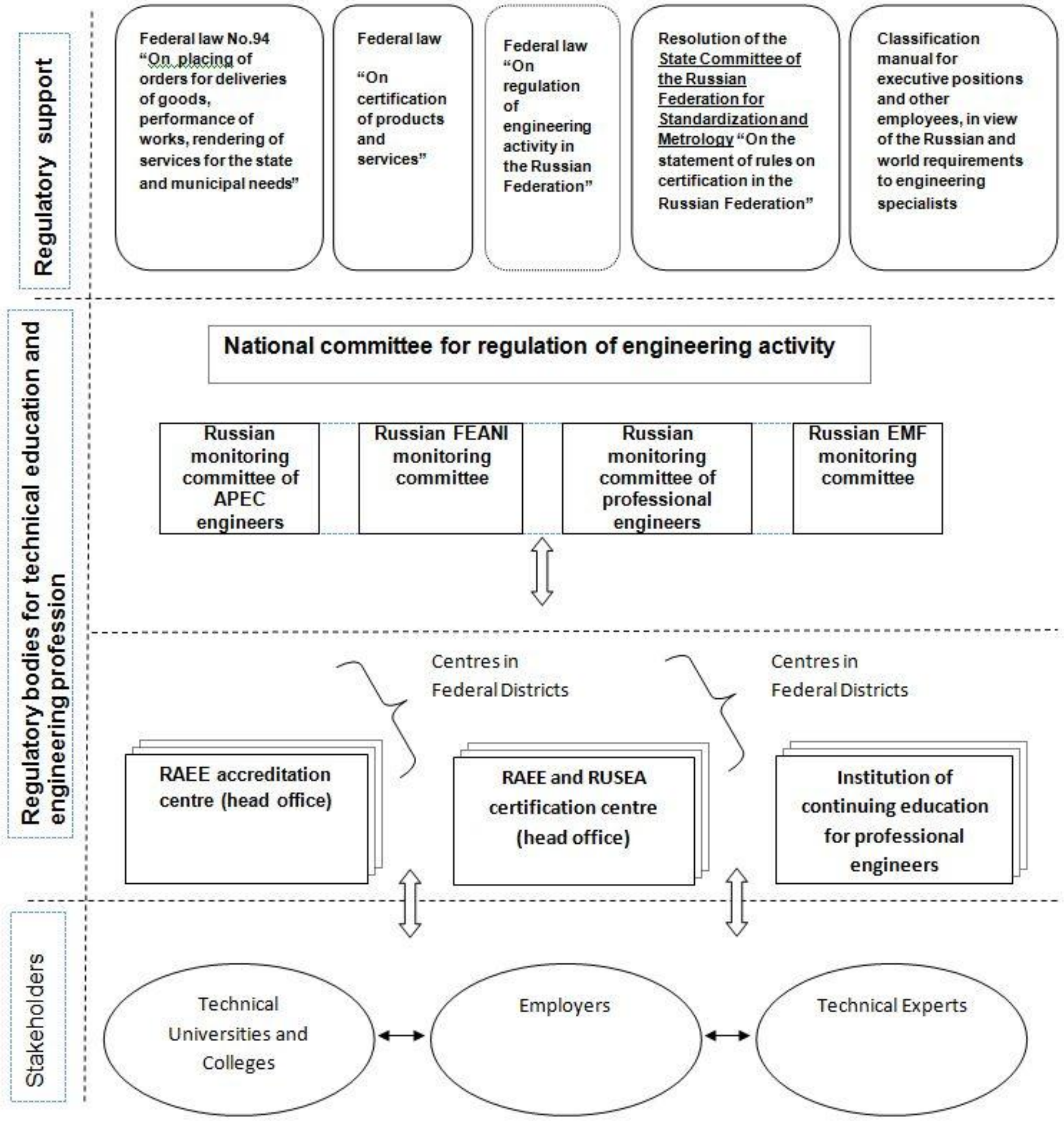

Figure 1. The structure of the national system of accreditation of technical education and certification of professional qualifications

The pilot stage of building of the national system of engineering activity regulation implies the following:

1) development and implementation of the standardized legal base regulating the place and the role of authorized public and professional bodies, requirements to professional engineers, procedures of their certification and registration, and the requirements to improvement of their professional skills;

2) development and bringing into force stimulating measures for non-government managing subjects aimed at attraction of professional engineers certified by international standards;
3) development of strategies aimed at obligatory job placement of professional engineers certified by international standards for state-owned corporations and companies.

The implementation of the above-stated steps is possible by introduction of amendments and additions to the existing legislation (for example, the Federal Law "On certification of products and services", the Federal Law "On additional education", the Federal Law No.94 "On placing of orders for deliveries of goods, performance of works, rendering of services for the state and municipal needs", the Resolution of the State Committee of the Russian Federation for Standardization and Metrology "On the statement of rules on certification in the Russian Federation", the classification manual for executive positions and other employees, in view of the Russian and world requirements to engineering specialists and so forth). The pilot stage of functioning of the system taking into account the existing law-enforcement practice should be completed with working out the Federal Law "On regulation of engineering activity in the Russian Federation" which will fully cover all important present-day issues concerning the development of technical education and engineering profession in Russia.

Table: Stages of building of the national system of engineering activity regulation

No.	Actions	Expected outcomes	Participants
1	The analysis of world experience of creating the systems of regulation of technical education and engineering profession, and the RF potential	1.1 Building the working group (WG) from among authorized representatives of interested parties 1.2 Basic principles of building the system of regulation of engineering activity	The interested ministries and departments of the Russian Federation: the Ministry of education and science, the Ministry of economic development, etc. - Representatives of professional community: the Russian Association for Engineering Education, the Russian Union of scientific and engineering associations, etc.
2.1	Stimulation of interested parties (universities, employers, technical experts) to more active involvement in public and	2.1.1 Package of additions and amendments in the current legislation 2.1.2 Discussion of amendments to	2.1.1 WG 2.1.2 2.1.2 Agency

	professional accreditation and professional certification of qualifications by introducing amendments to the current legislation	the profile ministries and departments 2.1.3 Introduction of amendments for consideration in the Federal Assembly of the Russian Federation, their approval and bringing them into force	for Strategic Initiatives (ASI) 2.1.3 2.1.3 ASI
2.2	Working out of the draft of the Federal law “On regulation of engineering activity”	The draft of the Federal Law	WG
3	Development of head centers on the basis of existing centers of certification (RAEE and RUSEA) and accreditation (RAEE). Opening of the regional centre of certification and accreditation in every federal district	Operating centers of certification of technical education and engineering profession (one head office center in every federal district)	WGs, Representatives of the RF President in federal districts
4.	Taking into account practical experience of construction and functioning of the national system of regulation of engineering activity, completion and bringing into force the Federal Law “On regulation of engineering activity”	Federal Law	ASI, WG

Long-term plans of participation in building the system of certification with ASI support

Nowadays one of the key bodies conducting the state policy in the field of building the National system of competencies and qualifications (NSCQ) is the Agency of strategic initiatives on advancement of new projects, a noncommercial autonomous organization which was established to execute a number of decrees by V.V. Putin on 17 May 2011.

The Russian Association for Engineering Education, the Russian Union of Scientific and Engineering Associations, the RF Chamber of Commerce and Industry proposed the initiative on advancement of the project aimed at creation of the NSCQ and building a network of international accreditation centers for technical education and certification of engineering qualifications. The project supports building a network of centers of international accreditation of technical education and certification of engineering qualifications on the basis of regional branches of the RF Chamber of Commerce and Industry authorized by the Russian Association for Engineering Education and the Russian Union of Scientific and Engineering Associations applying standardized international criteria and procedures. The project implementation will take 3 years. The key points of the project are as follows:

1. Establishing of operating centers of accreditation and certification in each of 8 RF federal districts on the basis of regional chambers of commerce and industry, authorized by the RAEE and the RUSEA applying standardized international criteria and procedures.
2. Formation, training and certification (by the RAEE and the RUSEA) of the groups of experts in the field of public and professional accreditation of technical education and certification of qualifications of professional engineers (not less than 50 in each Center). piloting of certification of technical education and engineering profession in the following areas:

- international public and professional accreditation in universities (not less than 150 educational programs for 3 years);
- international certification and registration of engineers (not less than 200 people).

3. Development of the draft of the federal law "On regulation of engineering activity in the Russian Federation".

The project target audience directly interested in its successful implementation includes three basic categories of customers:

1. developers of educational programs in engineering and technology, university entrants, teachers, and graduates who are interested international recognition of educational programs offered by technical universities;
2. secondary school leavers who plan to apply for the programs in engineering and technology, specialists professionally engaged in engineering activity, interested in international certification and registration and international recognition and competitiveness on the world labor market;
3. potential employers in the hi-tech economy sector interested in increase of global competitiveness due to highly qualified engineering staff having international certification. This category gets competitive advantages at participation in international bids or implementation of contracts with foreign partners.

The expected medium-term project outcomes are aimed at technological development of Russia, which implies improvement of the quality of engineering education and professional engineers' competence, international recognition of educational programs at technical universities and colleges and engineering qualifications, high competitiveness of Russian higher engineering schools and leading national hi-tech branches of industry and economy.

Successful implementation of the project seems realistic due to serious potential of project initiators. So, the RAEE as the member of the European network on accreditation in the field of engineering education (ENAEE) is developing the criteria and procedures meeting state-of-the-art international standards. For the time being, the RAEE has accredited over 200 bachelors, masters and specialists' programs in leading universities of Russia and Kazakhstan, including those assigned the EUR-ACE Label.

The university graduates who have mastered the programs accredited by the RAEE, have the possibility to receive a rank of the European engineer (EurIng) and to be registered in the FEANI Register and in the long term become the owners of the European Professional Engineering Card.

Besides, the RAEE is authorized in Russia as the organization that has the right to carry out international certification of engineers using the standards of the APEC Engineer Register.

Both *the APEC Engineer Manual* and *the IEA Graduate Attributes and Professional Competencies* enabled the RAEE to develop the organizational and methodological base for the national system of certification. Over 60 RF professional engineers working in hi-tech industries have been certified under the APEC Engineer Register international standards.

APEC Engineer Register, Challenges and the way Forward to Promote Mobility of Engineering Services

(*Mr Gue See Sew, Former Chair APEC Engineer Coordinating Committee)*

Background

The Asia Pacific Economic Cooperation Forum (APEC) is the Government consultative organisation of the 21 economies and regions (termed economies) in Asia and on the Pacific Ocean rim. The economies are Australia; Brunei Darussalam; Canada, China; Hong Kong, China; Indonesia; Japan; Korea; Malaysia; New Zealand; Papua New Guinea; Peru; The Philippines; Russia; Singapore; Chinese Taipei; Thailand; USA; and Viet Nam.

The APEC leaders' meeting in 1995 at Osaka agreed to the need of facilitating the mobility of qualified person among the member economies. Consistent with the Osaka Action Agenda, the meeting of 18 member economies of APEC Human Resources Development Ministers (HRD) in Manila in January 1996 urged the acceleration and expansion of project initiatives on mutual recognition of skill qualifications.

The main impetus came after the APEC HRD Working Group, which met in Wellington, New Zealand in January 1996, agreed to Australia's financial sponsorship on the Project focusing on professional engineering accreditation, recognition and development. The main aim is of course to develop Mutual Recognition Arrangement (MRA) to promote trades in services within the APEC region and mobility of engineers.

Eight member economies, Australia, Indonesia, Japan, Republic of Korea, New Zealand, Philippines, Thailand and United States of America, participated in the First Steering Committee Meeting of the Project held in Sydney in May 1996. The meeting agreed to proceed with a comprehensive survey on professional institutions and societies, registration of professional engineers, engineering education and continuing professional development. The results of the survey would form the framework for the best practices in professional engineering accreditation, recognition and development.

The Steering Committee had a number of meetings and workshops to deliberate the formation of APEC Engineer. Malaysia's participation begins in 1997, attending a workshop on APEC Engineer in Manila. At the Final Steering Committee Meeting and Inaugural APEC Engineer Coordinating Committee Meeting held in November 1999, the following founding members were admitted into the coordinating committee: Australia; Canada; Hong Kong, China; Japan; Korea; Malaysia; New Zealand and Thailand. The formal commencement year of the APEC Engineer Register started in 2000.

Currently, 14 of the 21 APEC member economies are authorised to operate APEC Engineers Register.

Objectives of APEC engineer

APEC Engineer aims to:

- Promote mobility of qualified engineers within APEC through mutual recognition of qualifications and experience based on substantial equivalence of engineering programme satisfying the academic requirements for the practice of engineering at the professional level.
- Establish a strong cooperative network among engineering organisations in APEC member economies, for trade services especially engineering services – growth and efficiency.

Definition of APEC engineer

An APEC Engineer is defined as a person who is recognised as a professional engineer within an APEC Economy, and has satisfied an authorised body in that economy, operating in accordance with the criteria and procedures approved by the APEC Engineer Coordinating Committee. They are required to have:

- Completed an accredited and/or recognised engineering programme;
- Been assessed within their own jurisdiction as eligible for independent practice;
- Gained a total of at least seven years of practical experience since graduation;
- Spent at least two years in responsible charge of significant engineering work;
- Maintained their continuing professional development at a satisfactory level.

Many of the APEC Economies are now full members of Washington Accord.

All practitioners seeking registration as APEC Engineers must also agree to be bound by the codes of professional conduct established and enforced by their home jurisdiction and by any other jurisdiction within which they are practising. Such codes normally include requirements that practitioners place the health, safety and welfare of the community above their responsibilities to clients and colleagues, practise only within their area of competence, and advise their clients when additional professional assistance becomes necessary in order to implement a programme or project.

APEC Engineers must also agree to be held individually accountable for their actions, both through requirements imposed by the licensing or registering body in the jurisdictions in which they work and through legal processes.

Route to become an APEC engineer

The route to become an APEC Engineer is to apply through an authorised register of APEC Engineer in an APEC economy. A professional engineer wishes to apply must first be a licensed or certified engineer to practice independently in that APEC Economy.

The APEC economy seeking to operate an authorised APEC Register must gather the representatives from government, industry, relevant professional institutions or associations and higher education institutions delivering engineering programmes and should be recognised as competent by the authorities responsible for registration and licensing within the economy.

A Monitoring Committee will be established to nominate a representative to participate as a non-voting member on the APEC Engineer Coordinating committee that has the ultimate authority for conferring an authorised register in an APEC economy.

The primary objective of the Monitoring Committee will be to develop and maintain a Register of APEC Engineers in compliance with the APEC Engineer Frameworks as shown in Figure 1.

The Monitoring Committee established will then draft Assessment Statement in accordance with the APEC Manual (http://www.ieagreements.com/APEC/Documents/APECEngineerManual.pdf) and provide a copy of the draft statement to the Secretariat of the APEC Engineer Coordinating Committee for circulation to all the official representatives of authorised APEC Registers. Currently 14 out of 21 APEC economies have authorised APEC Registers and the Secretariat of APEC Engineer is Institution of Professional Engineers New Zealand.

The Assessment Statement will be tabled and considered by the APEC Engineer Coordinating Committee according to the APEC Coordinating Committee Rules.

When approval is granted, the Monitoring Committee will provisionally be authorised to develop and maintain a Register in accordance with the Assessment Statement of Criteria and Procedures. The continued authorisation will be subject to periodical review, currently at an interval of a maximum of six years.

ASEAN engineering registration (AER) model

The mobility of engineering services within the ASEAN (10 nations) was initiated by private sector through engineering institutions in ASEAN at a conference of ASEAN Federation of Engineering Organisations (AFEO). It started with ASEAN Architects/Engineers Register and was amended to ASEAN Engineers Register in 1999 to focus and expedite promotion of benchmarking and mobility of engineers. In 2010, it became known as the ASEAN Engineering Register registering the whole engineering team comprises of ASEAN Engineers, ASEAN Engineering Technologists, ASEAN Technicians, Associate ASEAN Engineers, Associate ASEAN Engineering Technologists and Associate ASEAN Technicians *(Choo Kok Beng, 2012).*

Choo (2012) highlighted that the various titles awarded by the AER give peer recognition for their respective competencies and capabilities. It will accord them the necessary respect, recognition as an accredited technical person. This will enhance their employment prospects and business ventures into other ASEAN economies.

The public sector started to facilitate mobility of engineers in ASEAN after the signing of ASEAN Free Trade Area (AFTA) in 1992. The framework of Mutual Recognition Arrangement (MRA) of Engineering Services to support AFTA was later signed in 2005 which spells out the requirements for cross-border practice of professional engineering consultancy services for various engineering works.

Liberation of trade in services in ASEAN is designed through the mechanism of ASEAN Framework Agreement on Services (AFAS) signed in 1995. The MRA signed by ASEAN government ministers gives authority to Professional Regulatory Authorisation (PRA) of ASEAN Member economies on registration/licensing/certification of practice of engineering and monitoring and assessment of Registered Foreign Professional Engineers (RFPE) to ensure compliance with the MRA. The MRA emphasised collaboration with local Professional Engineers in the host economy and subject to their domestic laws and regulations governing the practice of engineering. The objectives of the MRA are:

- To enhance cooperation in services amongst Member States in order to improve the efficiency and competitiveness, diversify production capacity and supply and distribution of services of their service suppliers within and outside ASEAN;
- To eliminate substantial restrictions to trade in services amongst Member States; and

- To liberalise trade in services by expanding the depth and scope of liberalisation beyond those undertaken by Member States under the GATS with the aim to realising a free trade area in services.

The private sector is very active in many institutional activities such as the annual Conference of the ASEAN Federation of Engineering Organisations.

Engineers Mobility Forum

After the biennial meeting of the signatories to the Washington Accord on 27 and 28 October 1997, it was agreed that an independent forum to be known as Engineers Mobility Forum (EMF) to be established to explore mutual recognition for experienced engineers. The final Memorandum of Understanding Agreement to establish and maintain an international register of such engineers was signed at Thornybush in South Africa on 25 June 2001. This included a number of economies in addition to those of the Washington Accord.

To ensure consistency in application of the agreed criteria, ultimate authority for entering persons on the EMF Professional International Register will remain with an International Register Coordinating Committee.

EMF International Professional Engineer Register is essentially the same as APEC Engineer Register. The signatories aim to facilitate cross-border practice by experienced professional engineers by establishing a framework for their recognition based on confidence in the integrity of national assessment systems, secured through continuing mutual inspection and evaluation of those systems.

To grant entry into the EMF International Professional Engineer, an engineer must demonstrate that he/she have:

- Recognised Degree in Engineering substantially equivalent to a degree accredited by an organisation holding full membership of, and acting in accordance with the terms of the Washington Accord:
- Assessed in own economy as eligible for independent practice;
- Minimum seven years practical experience since graduation;
- At least two years in responsible charge of significant engineering work;
- Maintained continual professional development at satisfactory level.

Currently there are 15 full members and the registered engineers are as shown in Table 1. The Provisional member is Bangladesh. Pakistan was awarded interim authorisation to operate an EMF International Professional Engineer register in June 2011.

Challenges of the APEC engineer

The APEC Engineer register has been operating since year 2000. The registered APEC Engineers for each economy at June 2011 is shown in Figure 2. The growth for the last 10 years has been slow as shown in Figure 3. This number is small in comparison with the total professional engineers in the 21 economies. It is even smaller if it is compared with the total engineers including young engineers and professional engineers who are not licensed or certified to practice independently in their own economy. One of the criteria to qualify for APEC Engineer is having license International Engineer Register and certificate to practice independently.

When we compare with one benchmarking register such as EMF International Professional which started a year after APEC Engineer, the member of registered engineers in its 15 member economies is only about 60% of the registered APEC Engineers. The growth of it is also shown in Figure 3 and 14 member economies operate both the APEC Engineers and EMF International Professional engineers registers and most of them are having common monitoring committee members for the register.

In terms of ratio, EMF International Professional register covers areas with much bigger population but has lesser number of registered professional engineers in the register.

Another register was mooted by the active institution or societies of engineers in ASEAN which has 10 economies. Its register was started by AFEO without involvement of licensing or certification bodies for independent practice and has registered 2,040 engineers as at December 2011.

In 2005, the ASEAN economic ministers signed the ASEAN Mutual Recognition Arrangement on Engineering Services formation of ASEAN Chartered Professional Engineer (ACPE). This benchmark register, which is the main part of the Mutual Recognition Arrangement (MRA) is basically adopting the APEC Engineer Model but managed by Professional Regulatory Authority (PRA) in the 10 ASEAN member economies. Those ASEAN member economies without a Licensing board are in the process of setting up their Licensing board.

As at the end of December 2011, some 400 ACPE have been registered. In addition, the MRA specifies collaboration for local professional engineers engineering services. Thus, independent practice of an ACPE from an ASEAN member is not allowed in a host member economy.

Realising that majority of the engineering services is through integrated engineering services, AFEO has now introduced the following additional categories of registered engineering support staff:

1. ASEAN Engineering Technologists (AET),
2. ASEAN Technicians (AT),

3. Associate ASEAN Engineers (AAE),
4. Associate ASEAN Engineering Technologists (AAET),
5. Associate ASEAN Technicians (AAT).

The mobility of licensed professional engineers is generally small in comparison with the total population of engineers. In the case of Malaysia, the number of professional engineers licensed to practice independently is 10,423 which is less than 15% of the total registered engineers with the Licensing Board, Board of Engineers Malaysia as at April 2012. In Malaysia, the Engineers Act requires all graduate engineers working as engineers to register with the Board. Generally, the trend is also true in the other economies.

Fajar Hirawan and Wahyu Triwidodo (2011) have done a survey on the ASEAN MRA and found that many professional engineers do not register themselves in the ACPE Register. The reasons noted are:

- No significant benefit to be registered and become ACPE;
- No major difference for them before and after having certification as an ACPE;
- Lack of engineers working in destination economy and origin economy who earned an ACPE;
- No clear paths in using the ASEAN certification;
- Lack of promotion in the register.

Nevertheless, Benchmark Registers are necessary MRA to facilitate mobility of engineers in promoting liberation of trade in services.

The APEC Engineer Register should be promoted as the recognised register in the MRA for bilateral or multilateral trade negotiations between APEC economies. Thus, representatives of APEC Engineer Registers should work with their respective government agencies in charge of trade negotiation to promote APEC Engineer Register as the MRA. This will provide the impetus to expedite trade in engineering services.

The benefits of APEC Engineers include:

- Benchmark of achievement of Professional engineers.
- Migration of the imbalance of demand and supply of engineers within economies in the region.
- Better use of technology and resources.
- Technology transfer.
- Common code of practice and standard for the regional with national annex to suit each national need and affordability while maintaining the minimum standard of the regional for trade purpose.

The way forward

The way forward to achieve the full potential of the APEC Engineer on mobility of engineers is to integrate benchmarking and trade negotiation through public and private partnership together with the input professional bodies such as Institution of Engineers and licensing or certification board of engineers for practice.

Trade in services includes plant and equipment, products including materials, engineering design and construction management such as Engineering Procurement and Construction Management (EPCM) which is the bulk of the trade while engineering design is a small portion of the total trade in engineering services.

This integrated engineering service is classified under World Trade Organisation (WTO), CPC 86733 while the CPC 68732 covers engineering design services. Consequently, trade in services should include young engineers, technologists and technicians.

The linkage of APEC Engineer with the International Benchmarking bodies and WTO, regional as well national government leaders are shown in Figure 4.

Multilateral agreement in regional and International trade organization also encourages the use of bilateral agreement to expedite MRA in the trade negotiation to improve trade in services. The benchmarking register of APEC should be used as the MRA for the trade in within APEC economic.

The statistics in Figure 3 show that the number of registered engineers in APEC is much higher than the EMF International Professional Engineers. The main reason to this is the involvement of APEC Economic Ministers in the APEC Engineer.

In fact, the benchmarking of the APEC Engineer was mooted by APEC Human Resources Development Ministers (HRD) in Manila in January 1996 urging the acceleration and expansion of mutual recognition of skill qualifications to facilitate trade within the region.

Trade within the 21 economies of APEC will of course complement the initiative of World Trade Organisation (WTO) in liberalising world trade.

Bear in mind that the code of practice and standard as well as quality of engineering plant and equipment should achieve a minimum standard for cross-border trade. Nevertheless, the need and affordability within an economy could vary from the economies in the regions.

Continuous promotions of APEC Engineer Register through various national, regional and international activities as well as harmonisation of engineering education accords and registers are needed. This will promote better use of resources in assessment of standards, monitoring and review of accords and registers.

References:

1. Choo K.B. (2012), “The ASEAN Engineering Community in 2015”, 2^{nd} Engineering Summit, Manila, Philippines.

2. Fajar B. Hirawan & Wahyu Triwidodo (2012), “Examining the ASEAN Mutual Recognition Arrangement (MRA) Implementation Process on Engineering and Architectural Services and Its Impact to the Professionals: Indonesian Perspective”, Structural Reform, Services and Logisitics - Building Policy Making Capacity in APEC/Services Workshop 2012, Jakarta, Indonesia.

3. http://www.aseansec.org

RAEE Activity on Professional Accreditation of Educational Programmes

(Prof D.Sc. Yury P. Pokholkov RAEE President, Head of the Department on Organization and Technology of Higher Professional Education, Tomsk Polytechnic University)

Russian Association for Engineering Education (RAEE) was established in 1992. The main goal of the RAEE is to facilitate the improvement and development of engineering education and engineering activity in Russia.

There are several non-governmental organizations in Russia, besides the RAEE, dealing with problems of education quality improvement, such as Technical Universities Association, Coordination Council for Independent Public and Professional Accreditation, Russian Union of Industrialists and Entrepreneurs, Union of Scientific and Engineering Associations (Societies), Association of Non-governmental Organizations "International Union of Instrument and Information Technology and Telecommunications Engineers", Intellectual Fund of Russia: education, science, innovation, etc.

The RAEE either cooperates with the majority of these organizations or is their founder or member. For example:

Intellectual Fund of Russia: education, science, innovation

Non-governmental organizations:
- Russian Rectors' Union
- Association for Medical and Pharmaceutical Higher Education
- Association of Transport Higher Education Institutions
- ***Russian Association for Engineering Education***
- Association of Classical Universities of Russia
- Association of Language Higher Education Institutions
- Association «National United Aerospace University»
- Russian Association of Non-government Higher Education Institutions
- Association for Development of Pedagogical Universities and Institutions
- Association «Promotion of Higher Education Institutions»
- Association of Construction Higher Education Institutions
- Technical Universities Association
- Association of Arts Educational Institutions
- Eurasian Distance Learning Association
- Eurasian Association of Universities
- International Association for Automobile and Road Transport
- International Association for Trade and Economic Education
- Interregional Association «Agricultural Education»

Russian Union of Scientific and Engineering Associations (USEA)
Professional communities and associations (35)

1. Engineering Universities Association;
2. International Engineering Academy;

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9. ***Russian Association for Engineering Education;***

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31. Scientific and Engineering Association for paper and woodworking industry;
32. Russian Scientific and Engineering Association for water transport;
33. Bioengineering Association;
34. Engineering Research Union;
35. International Scientific and Engineering Association for light Industry;

Foundation for International Accreditation and Certification Assistance in the Field of Education and High Technologies (FIACA)

Founders:

- «Russian Association for Engineering Education»
- Russian Academy of Sciences
- Association of Technical Universities supported by the Ministry of Education of the Russian Federation

Agreements

The RAEE works on the development of public and professional accreditation system in Russia since 1997.

The RAEE is supported by and cooperates on an ongoing basis with government organizations responsible for education in the Russian Federation.

On 21October 2002 the Ministry of Education of the Russian Federation and the Russian Association for Engineering Education signed the Agreement on joint activity aimed at the development of public and professional accreditation system for higher education programmes in engineering.

The Order of the Ministry of Education of the Russian Federation dated 27.05.2003 «On development of public and professional accreditation system for higher education institutions running engineering educational programmes», requires that the results of the RAEE activities in the sphere of public and professional accreditation be analyzed and taken into account by the Department for Licensing, Accreditation and Certification and the State Inspection for Certification of Educational Institutions in Russia.

On 4 February 2005 The Agreement between the Russian Association for Engineering Education and the Federal Education and Science Supervision Service was signed for the purpose of engineering education quality improvement and training of engineering specialists for Russian industry through the development and improvement of national systems of public and professional accreditation of educational programmes.

On 12 December 2006 Federal Education Agency of the Russian Federation sent the letter № 05-58-1110/12-16 to rectors of universities with the recommendation to undergo the RAEE public and professional accreditation with application for the international certificate EUR-ACE.

In 2004 the RAEE and the Russian Chamber of Commerce and Industry signed the Agreement on cooperation on issues relating to training and continuing education of engineering specialists.

Structure of RAEE Accreditation Centre

The Accreditation Centre (AC) is a department of the Russian Association for Engineering Education responsible for accreditation of educational programmes.

The Centre comprises Accreditation Board, Methodological Committee, regional departments and RAEE experts (Figure 1).

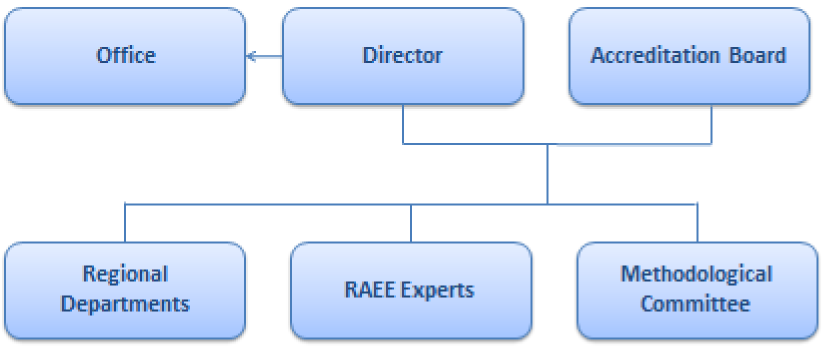


Figure 1. Structure of RAEE Accreditation Centre

The Accreditation Board (AB) consists of leading specialists in the field of engineering education representing different communities (Figure 2).

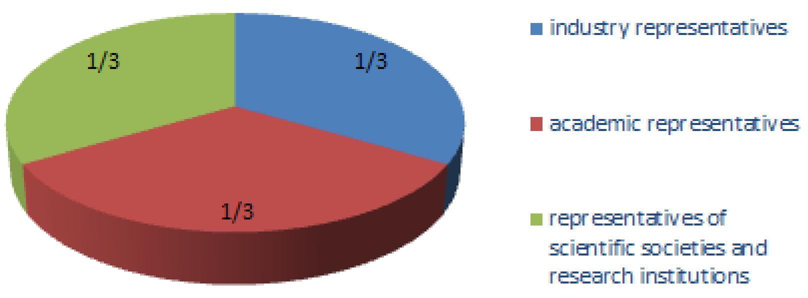


Figure 2. Accreditation Board Composition

Chairman of the Accreditation Board is elected by a simple majority of AB members' votes and is approved by the RAEE Board. One third of the Accreditation Board is replaced triennially.

Accreditation Procedure

1. Application
2. Conclusion of a Contract
3. Self-Assessment
4. Accreditation Visit
5. Final Report Preparation
6. Accreditation Board Decision
7. RAEE Board Decision

In case the educational programme is accredited with award of EUR-ACE® Label, the AC RAEE issues an appropriate certificate, signed by the RAEE and ENAEE presidents. The accredited programme is included in the ENAEE register.

RAEE Criteria

1. Programme Educational Objectives
Programme objectives must be consistent with the state educational standards and the needs of potential constituencies. The objectives must be clearly defined and published.
2. Programme Content
Programme content must be equivalent to not less than 300 ECTS credits for Integrated Second Cycle programmes, not less than 240 ECTS credits for Bachelor programmes, not less than 120 ECTS credits for Master programmes. Curriculum must be consistent with the programme objectives and ensure the attainment of the programme outcomes.
3. Students and Educational Process
The programme must ensure that all students attain programme objectives. Students must have opportunities for work practice and participation in academic mobility programmes.
4. Faculty
The members of the faculty must be highly qualified, take part in research work and understand the roles of their subjects in the training of an engineer.
5. Professional qualifications
The programme must prepare students for engineering practice through the whole period of study. Graduates must have enough knowledge on engineering disciplines, engineering analysis, engineering design etc.
6. Facilities

Facilities must conform to the state requirements, be modern and adequate to meet the programme objectives. Resource base must be renovated and developed on an ongoing basis.

7. Information resources

Information resources must be adequate to meet the programme objectives. The resources must be renovated and developed on an ongoing basis.

8. Finance and management

The programme financial resources must conform to the state requirements. The financial policy and management must be aimed at improvement of the programme quality.

9. Graduates

The system of placement monitoring and career development of the graduates must be used for further development of the programme.

Leading experts:

1. Gerasimov Sergey Ivanovich, Siberian transport university, professor of cathedra «Structural mechanics», doctor of engineering.
2. Gryaznov Oleg Nikolaevich, Ural state mountain university, head of cathedra «Hydrology and geological engineering», professor, doctor of geological and mineralogical sciences.
3. Larionov Nikolay Mikhaylovich, Moscow state institute of electronic engineering, professor of cathedra «Industrial ecology», candidate of engineering.
4. Pecherskaya Rimma Mikhaylovna, Penza state university, dean of faculty of natural science, nanotechnologies and radio electronics, professor, doctor of engineering.
5. Surigin Alexander Igorevich, St. Petersburg polytechnic university, head of cathedra «Mathematics», professor, candidate of physical and mathematical sciences, doctor of education.
6. Shaposhnikov Sergey Olegovich, St. Petersburg state electrotechnical university, vice rector for international relations, candidate of engineering, associate professor.

Training of Experts

The RAEE conducted a series of training courses in order to set up several expert teams in different engineering fields of study and to form an expert database. Presently the database includes about **200** experts – representatives of leading technical universities and industry specialists. Besides, there is a database of “nominees for experts” which includes people who participated in workshops and got certificates but have not yet taken part in accreditation visits.

10 February 2003, Saint-Petersburg, the AC RAEE workshop «Public and professional accreditation criteria and procedure»; 50 participants, 14 certificates issued.

11-13 November 2003, Moscow, the AC RAEE workshop «Public and professional accreditation of engineering educational programmes» within the international symposium «Elite technical education»; 43 participants, 19 certificates issued.

3-5 February 2004, Saint-Petersburg, the AC RAEE workshop «Public and professional accreditation criteria and procedure»; 33 participants, 16 certificates issued.

4 February 2005, Moscow, the RAEE and the Federal Education and Science Supervision Service workshop «Higher education quality in engineering»; more than 100 participants, 30 certificates issued.

1-2 April 2005, Tomsk, the AC RAEE and TPU workshop «Higher engineering education quality assurance. RAEE experts training»; more than 50 participants, 34 certificates issued.

11 November 2005, Moscow, the AC RAEE workshop «Assessment of engineering specialists training quality»; more than 50 participants, 40 certificates issued.

1-2 March 2006, Moscow, international RAEE and ATU workshop «European quality and accreditation system of engineering education»; more than 70 participants, 25 certificates issued.

28-29 September 2006, Moscow, ABET International Faculty Workshop, more than 60 participants, 32 certificates issued.

27-28 March 2007, Moscow, the AC RAEE workshop «Public and professional accreditation of engineering educational programmes» within the international symposium «Innovative engineering education and specialists training»; more than 60 participants, 23 certificates issued.

9-11 May 2007, Rome, the AC RAEE workshop «Continuing training of experts in engineering educational programmes quality evaluation» within the PRO-EAST project; 20 participants, 10 certificates issued.

20 November 2008, Tomsk, the AC RAEE workshop «Public and professional accreditation of engineering educational programmes», 35 participants, 27 certificates issued.

20 May 2009, Saint-Petersburg, the AC RAEE workshop «Public and professional accreditation of engineering educational programmes» within the International Forum on Engineering Education, 32 participants, 24 certificates issued.

13 November 2009, Tomsk, the AC RAEE workshop «Public and professional accreditation of engineering educational programmes», 18 participants, 15 certificates issued.

Experts, Statistics

The expert database is updated and analyzed annually.

The data as of 01.03.2010:

Qualitative composition of experts:

- Professors — 51%
- Associate professors — 49%

Qualitative composition of nominees for experts :

- Professors — 70%
- Associate professors — 30%

Qualitative composition of experts (academic degree):

Doctor:	**44,5%**
Doctor of Engineering	34,5%
Doctor of Physics and Mathematics	7%
Doctor of Geology and Mineralogy	1%
Doctor of Biology	1%
Doctor of Pedagogy	1%
Candidate:	**55,5%**
Candidate of Engineering	41,5%
Candidate of Physics and Mathematics	12%
Candidate of Chemistry	1%
Candidate of Pedagogy	1%

Qualitative composition of nominees for experts (academic degree):

Doctor:	**61%**

Doctor of Engineering	48%
Doctor of Physics and Mathematics	10%
Doctor of Economics	1,5%
Doctor of Pedagogy	1,5%
Candidate:	**39%**
Candidate of Engineering	31%
Candidate of Physics and Mathematics	5%
Candidate of Biology	1,5%
Candidate of Economics	1,5%

In 2009 higher education institutions of the Republic of Kazakhstan submitted their educational programmes for accreditation in the RAEE.

Altogether, **134** educational programmes have been accredited (129 – first-time accreditation, 5 – reaccreditation) in **27** Russian higher education institutions and **2** higher education institutions of the Republic of Kazakhstan. **134 RAEE** certificates and **53 EUR-ACE** certificates were issued. The following table shows the amount of accredited programmes in each higher education institution.

Work Schedule for 2010

During the first six months of 2010 the AC RAEE will finish the accreditation procedure for 22 educational programmes of 8 higher education institutions, including 8 educational programmes of 2 higher education institutions of the Republic of Kazakhstan.

14 educational programmes of 4 Russian higher education institutions and 12 educational programmes of 2 higher education institutions of the Republic of Kazakhstan submitted for accreditation in 2010/2011.

6 educational programmes of 3 Russian higher education institutions and 4 educational programmes of 2 higher education institutions of the Republic of Kazakhstan are in the process of developing applications for accreditation in 2010/2011.

Due to a great amount of applications submitted by higher education institutions the RAEE Board is going to consider the expansion of accreditation activity in the field of information technology, science and mathematics.

Education. Prospects

The RAEE has already done a great deal of work in the field of engineering education quality improvement in Russia. Present situation proved appropriateness of the RAEE activity in the sphere of accreditation of educational programmes and affirmed the necessity to develop engineering qualifications certification in Russia and abroad.

Presently it is fair to say that the system of engineering educational programmes accreditation in Russia has been successfully established.

The statistic shows that there is a growing interest for engineering educational programmes accreditation. The RAEE has developed the database which includes the register of accredited programmes, the expert database, the nominees for experts database, etc.

It is impossible to achieve international recognition of Russian engineering qualifications without engineering qualifications certification in Russia.

The next logical step for the RAEE is establishment of the system of engineering qualifications certification in Russia and development of Russian register of professional engineers.

To complete this task the RAEE has been studying international experience and has been conducting research with the purpose to develop the criteria of engineering qualifications.

Engineer Certification Requirements:

1. Graduation from the accredited educational programme.
2. Work experience.
3. Professional examination.

Russian Association for Engineering Education keeps a register of accredited programmes graduates which is already a prototype of the future Register of Russian professional engineers. Presently it contains 1799 names and is constantly increasing.

Current Situation of Education and Qualification of Engineering Professionals in Japan

(Prof Itsuo Ohnaka, President of Monitoring Committee of APEC Engineer in Japan, Chair of Accreditation Committee of Japan Accreditation Board for Engineering Education, Prof. Emeritus of Osaka University)

Introduction

The roll of engineers has been increasing with the development of science and technology, because engineering greatly affects not only the economy but also safety of societies and nations. The professional engineer system is one of the systems to keep the society safe and healthy. However it does not work if engineers are not well educated and the qualification is not adequate. This paper briefly looks back the education and qualification of engineers in the last twenty years in Japan.

National qualification of engineers and related organizations

Japan has two types of national qualification of professional engineers; one is called *Gijutsushi* in Japanese or Professional Engineer, Japan (P.E.Jp) in English and the other is *Kenchikushi* in Japanese or Architect and Building Engineers in English. The qualifications are based on the *Gijutsushi* and *Kenchikushi* Laws, respectively. Currently, only *Gijutsushi* and 1st-class *Kenchikushi* are eligible to apply the APEC Engineer (APEC P.E.Jp) and EMF International Professional Engineer (Int.P.E.Jp). Please note that the education of architect engineers is rather unique, because they are educated in engineering schools not in art schools unlike many other economies. Further, *Kenchikushi* is a monopoly business qualification and P.E.Jp is just a monopoly qualified name, while P.E.Jp qualification is often required in some areas such as civil and construction engineering business.

Gijutsushi (P.E.Jp) and *Gijutsushikai* (IPEJ)

The *Gijutsushikai* (it was called "Japan Consulting Engineer Association (JCEA)" before 1984 and now "the Institution of Professional Engineers, Japan(IPEJ)") was founded to promote establishment of the professional engineer system in Japan in June 1951 and the first PE act was established in May 1957. The PE Act (Law No. 25/1983) was amended in April 1983 to separate the professional engineer examination into two stages and to set up of the associate professional engineer qualification. In Feb.1984 "The *Gijutsushikai* (IPEJ)" was designated based on the PE Act amended in 1983 as the sole examination and registration organization in charge of clerical work with respect to implementation of examination and registration for P.E.Jps. The IPEJ is a public association whose regular members are P.E.Jp based on the PE Act and is administered by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

Kenchikusi (Architect and Building Engineers)

The Ministry of Construction directly administered the examination and registration of *Kenchikusi* from 1951 to 1984. In 1984 Japan Architectural Education and Information Center (JAEIC) has been authorized by the government as the centrally-designated examination organization for 1st-class *Kenchikushi*, and also has been authorized by prefectural governors as the prefecturally-designated examination organization for 2nd-class *Kenchikushi* and *Mokuzo-Kenchikushi* since 1985. The registration of *Kenchikushi*, however, has been managed until 2008 by the Ministry of Construction which was merged with other Ministries such as Ministry of Transportation into the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in 2001. In 2008 the Japan Federation of Architects and Building Engineers Associations (JFABEA) has been authorized by MLIT as the sole organization to do clerical works of registration of *Kenchikushi*. Today JAEIC and JFABEA are administered by the MLIT under the *Kenchikushi* Law.

Educational system

The compulsory education is 9 years from the primary (6-12) to middle (12-15) schools. High schools (15-18), both general and vocational, enroll about 96% of the age group in their first year and graduate about 90%. Two-year colleges (18-20) and four-year universities (18-22), with both vocationally specific and vocationally unspecific courses, which enroll nearly 50% of the age group in their first years and graduate over 90% of them. There are five-year Colleges of Technology (15-20) most of which belong to Institute of National College of Technology, Japan, and yield about two per cent of the age group. These five-year Colleges have 2-year advanced courses which are equivalent to undergraduate schools in universities and the students finished these courses can get bachelors degree from National Institution for Academic Degree and University Evaluation (NIAD-UE). A university can establish a graduate school. A graduate school offers master, doctoral and/or professional degree programs and is usually located in the university.

There are about 1400 engineering programs in about 300 schools including agriculture schools, yielding about 950,000 bachelors and 37,000 masters per year in 2011.

Change in education and qualification of engineers -The Roaring Nineties and today

Nineties were not only the last decade of the 20th century but also the lost decade in Japan after the Japanese asset price bubble collapse or the collapse of booming economy flattered as “Japan As Number One”. Further, the cold war ended in 1991, causing a lot of dreams and difficulties for the people in communist and related economies but also causing globalization of economy or severe global competition. Also there have been a lot of accidents such as *Shigaraki* train disaster killed 42 people in 1991, nuclear accident (criticality accident) at *Tokaimura*, etc in Japan in 1999.

The Japanese government which was affected by the policy of United States introduced deregulation policy in various fields under the slogan from *Catching-up era to Front-runner era*, hoping to revamp the Japanese economy, expand domestic demand and encourage imports. Together with the global change in economical situation, this deregulation policy caused Roaring Nineties or Strum und Drang era and greatly affected the engineering education and professional engineer system in Japan.

Change in Primary and secondary education

In 1987, the School Curriculum Council submitted four basic core principles to improve education in kindergartens, elementary schools, and junior and senior high schools;

1) To equip pupils with strength, confidence, and open minds.
2) To create self-motivated pupils able to deal with changes in society.
3) To teach the fundamental knowledge needed by Japanese people and to enrich education to respect individuality.
4) To educate pupils to be able to understand international society as well as Japanese culture and traditions.

The background was that the number of pupils dropped out from primary and secondary education drastically increased in eighties and they thought that the education too much focused on knowledge and skills should be changed to the education with a new concept of scholastic ability which is focused on the learning process, change in children, thinking and problem solving abilities and characteristics of children. The evaluation was also shifted to interest, willingness and attitude of pupils. The roll of teachers is expected to change from teaching to assistance, encouragement and coaching.

Based on the concept, in 1989, science and social studies classes were strangely abolished and "environmental studies" was introduced in the lower grades of elementary schools. In middle schools, the number of elective classes was increased to motivate students. From 1992, schools closed on the second Saturday of every month, and from 1995 schools closed on the fourth Saturday to increase student spare time. In 1996, the 15th Central Council for Education submitted a report suggesting "the ability to survive" should be the basic principle of education in the 21st century. "The ability to survive" is defined as a principle that tries to keep the balance of intellectual, moral, and physical education. Based on the suggestion, 30% of the curriculum was cut and "time for integrated study" in elementary and middle schools was established in 1998.

Such education is called "relaxed education" and was severely criticized because knowledge education was too much decreased, while the new concept itself was not bad at all. Therefore the education has been changed to increase learning time and contents from 2003 and significantly from 2008. The higher education has been giving remedy education for students who educated under "the relaxed education".

Change in higher education

The deregulation policy also caused significant amendments of educational laws in 1991, including the *Standards for the Establishment of Universities* and the *School Education Law*. This was undertaken in order to make existing systems more flexible, thereby enabling each university to develop its distinctiveness under its missions and goals, with respect to the progress of academic research and public interests. However, this deregulation accelerated university education from elite- to mass- and further to universal access-type, decreasing the average level of graduates.

In order to improve quality assurance of higher education, self-assessment was stipulated as a task which universities should strive to implement and in 1999 the self-assessment was made compulsory for every institution. The principle was that prime responsibility for quality assurance of higher education rests with individual higher educational institution. In 2000 NIAD-UE was established to do institutional evaluation. This is a kind of institutional accreditation and program accreditation was not pursued officially, while the government supported the establishment of JABEE which was described below.

To cope with the international movement in professional engineer systems described later in 4.3 and also in order to respond to the request of the quality assurance, various meetings and committees have been set-up in JSEE (Japanese Society for Engineering Education) and JFES (Japan Federation of Engineering Societies) from 1996 to 1999, and the accreditation system for engineering education including criteria and examination procedures, etc were planned. Eventually, JABEE has been launched in November of 1999. JABEE was accepted by the Washington Accord (WA) as a provisional member in 2003 and a regular member in 2005.

The problems we faced in the initial stage of establishing the accreditation system were as follows:

1) Understanding and dissemination of concept such as quality assurance of education, accreditation and outcomes;
2) Evaluation methods of outcomes;
3) Training of examiners;
4) Lack of understanding of profession and engineering;
5) Fixed idea that university should teach truth and scholarship or theory and should not be vocational one;
6) Belief that their quality is high enough.

To solve these problems we sent many people to WA economies to attend workshops and accreditation visiting as observers, and held symposiums and workshops inviting lecturers from ABET or other foreign organizations.

Change in Professional engineering system

The General Agreement on Trade in Services (GATS), which is a treaty of the World Trade Organization (WTO), entered into force in January 1995 as a result of the Uruguay Round negotiations. The treaty was created to extend the multilateral trading system to service sector including professional engineers. In accordance with the movement, APEC economic leaders met at Osaka Summit Meeting in November of 1995 and declared to accelerate the implementation of the Uruguay Round commitments and the Osaka Action Agenda[1] said " APEC economies will undertake Human Resources Development Program 21, consisting of twenty-one sub-programs. In this program, APEC economies will, *inter-alia*:...*(a-e are skipped)* f. facilitate the mobility of qualified persons in the region through bilateral agreements between interested APEC economies for the mutual recognition of professional qualifications,…". Consistent with this Agenda, the APEC HRD Working Group held in 1996 in Wellington, New Zealand, agreed to an Australia initiation on the project, focusing on professional engineering accreditation, recognition and development. At the first Steering Committee meeting held in May 1996 in Sydney, Australia, a consensus was reached to proceed with a comprehensive survey on professional institutions and societies, registration of professional engineers and engineering education and development. The results of that would form the framework for the best practices in professional engineering accreditation, recognition and development.

To cope with such international movement we have created committees to establish accreditation system and reform the PE act in order to establish substantially equivalent systems to other economies. The discussion on the latter has been made in the IPEJ communicating with MEXT and other ministries.

Establishment of Japan APEC Engineer Monitoring Committee

Based on the decision of the first Steering Committee for APEC Engineer Project Stage 3, the Japan APEC Monitoring Committee was established on January 20, 1999, under an agreement among the governmental authorities concerned such as MEXT, METI, MILT and foreign affairs.

The activities, membership, operations and secretariat are as follows:

1) Activities

- Activities related to the design of criteria for the assessment of Japanese engineers who wish to be registered on the.
- APEC Engineer Register and procedures for entry of such engineers into the APEC

Engineer Register.

- Activities related to the assessment of Japanese engineers who wish to be registered on the APEC Engineer Register.
- Activities related to the registration of eligible Japanese APEC engineers into the APEC Engineer Register.
- Activities other than those described above.

2) Secretariat

The general affairs of the Monitoring Committee are handled by IPEJ.

3) The Assessing Body for Professional Engineers, Japan

When to assess applicants who have the qualification of P.E.Jp, the Monitoring Committee entrusts part of its assessment activities to IPEJ, which has set up the Assessment Committee for executing the activities.

4) The Assessing Body for 1st-class *Kenchikushi* (Licensed Architects/Building Engineers)

When to assess applicants who have the qualification of 1st-class *Kenchikushi* and specialize in building structures, the Monitoring Committee entrusts part of its assessment activities to JAEIC, which has set up the Building Engineer Qualification Committee for executing the activities.

Amendment of the PE Act

An amendment was made to make passing the first stage exam a prerequisite for application to the second exam to become a P.E.Jp. From November 2000 implementation of APEC Engineer (Civil engineer and structural engineer), assessment and registration was started. The English name of the *Gijutsushikai* was changed to "IPEJ" after amendment of the PE Act in April 2000. APEC Engineer assessment and registration was expanded to all technical disciplines and optional Subjects in April 2006.

The amendment made for the Professional Engineer Law in May 2002 added a technical discipline "Nuclear & Radiation". The MEXT ratified and notified the names of those engineering courses that were accredited by the JABEE in March 2004. Graduates from those accredited courses are to be exempted to take First-Stage Professional Engineer Examination under the Article 31.2.2 of the Professional Engineer Law.

Bilateral agreement and enlargement of disciplines

On 1 October 2003, "A Bilateral Framework to Facilitate Mobility for Mutual Recognition of Registered / Licensed Engineers" was concluded between the MEXT, and IPEJ as Japanese side, and Engineers Australia and National Engineering Registration Board as Australian side. Based on this agreement, the Monitoring Committee has started assessment and registration of APEC Engineers in the disciplines of "Mechanical", "Electrical" and "Chemical" from November 2003, in addition to those of "Civil" and "Structural" which were started from November 2001. The number of members of the Monitoring Committee also increased in order to respond to these enlarged registrations of engineering disciplines.

Establishment of the EMF Engineer Monitoring Committee

The EMF Engineer Monitoring Committee was established on November 16th 2006, under the approval of the IPEJ board meeting. The difference between the APEC and the EMF Engineer Monitoring Committee is that the former is strongly associated with the related Ministries and hence requires authorization from the Ministries, while the latter is not. The activities, membership, operations and secretariat are almost same with the APEC Engineer Monitoring Committee.

Change in *Kenchikushi* law

Safety issues caused by a structural calculation forgery scandal where a 1st-class *Kenchikushi* falsified the report of structural calculation documents and 8 people were arrested for violations of the Architect Act and other laws in 2006 forced the MLIT to amend the *Kenchikushi* law for securing the safety of buildings and regaining the credibility of *Kenchikushi* in 2008. One of the major amendments to the *Kenchikushi* Law was the creation of two new licenses, based on the expertise of *Kenchikushi*: 1st Class Structural Design *Kenchikushi* and 1st Class Building Equipment Design *Kenchikushi*, both of whom require highly specialized knowledge and skills. As a result of this amendment, buildings of a certain size or larger must be either designed or reviewed by 1st Class Structural Design *Kenchikushi* and 1st Class Building Equipment Design *Kenchikushi* to ensure that they meet the structural and building equipment requirements stipulated in the Building Standard Law (BSL). In addition, to improve the quality and performance of *Kenchikushi* who are already licensed, they will be required to attend regular seminars to update their knowledge and skills.

Also JFABEA has been authorized by MLIT as the sole organization to do clerical works of registration of *Kenchikushi* in 2008.

Current accreditation system for engineering education

Unlike many other economies such as Australia, the accreditation body in Japan (JABEE) is independent from the IPEJ. Namely, JABEE is an independent public organization just like ABET in USA. Figure 1 and 2 show the structure of JABEE and the relationship among JABEE and other organizations, respectively.

When an engineering program wants to be accredited, it applies JABEE for accreditation examination. JABEE asks major engineering societies to recommend examiner candidates, and appoints examiners. One examination team consisting three examiners including one examiner from industry in principle examines one program through a self-assessment report and campus visiting. The results are coordinated by discipline-based examination committees comparing examination results of similar programs and further by the coordinating committee of examination and accreditation comparing the results of different fields. The accreditation commission makes final decision whether to accredit. The decision results are approved by the board of directors and publicized.

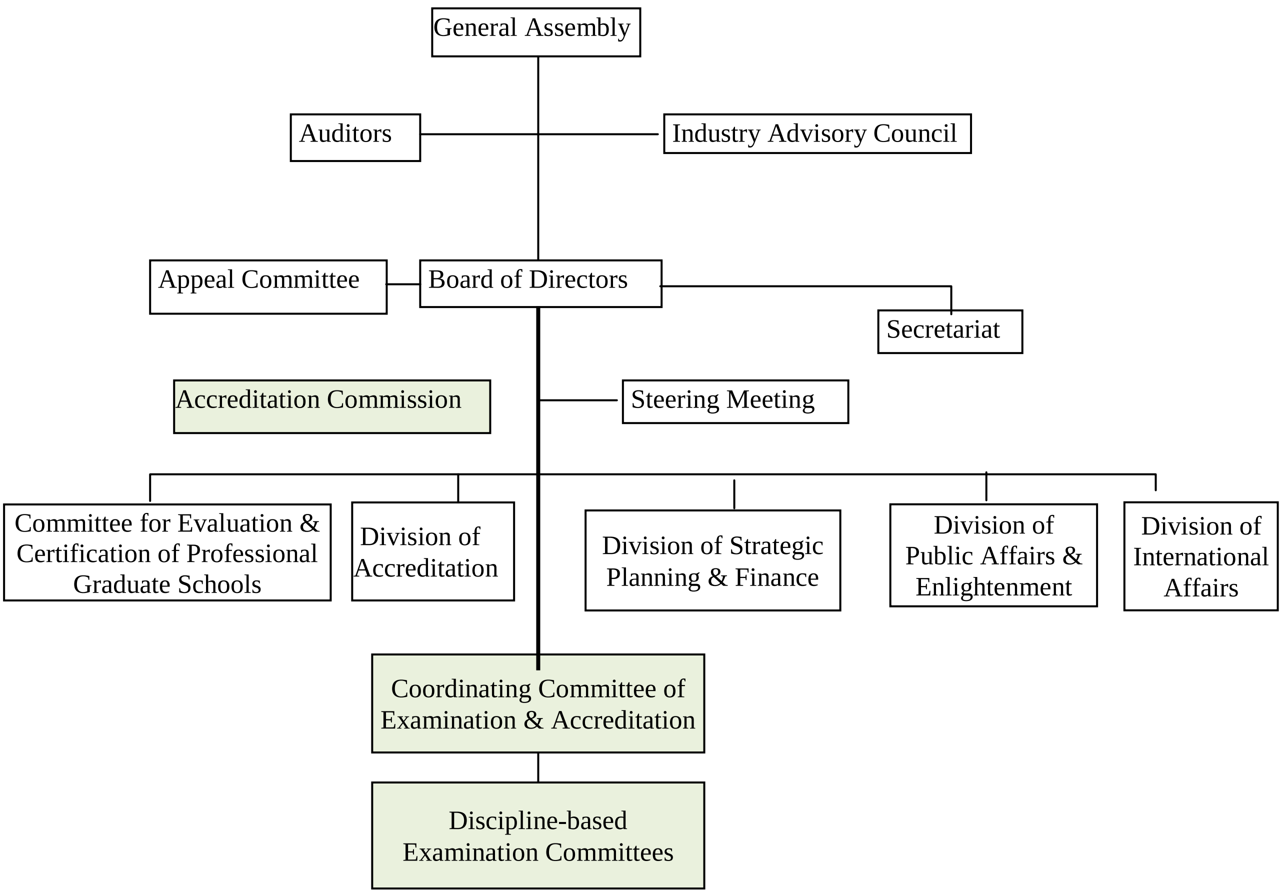


Figure 1. Structure of JABEE in 2012

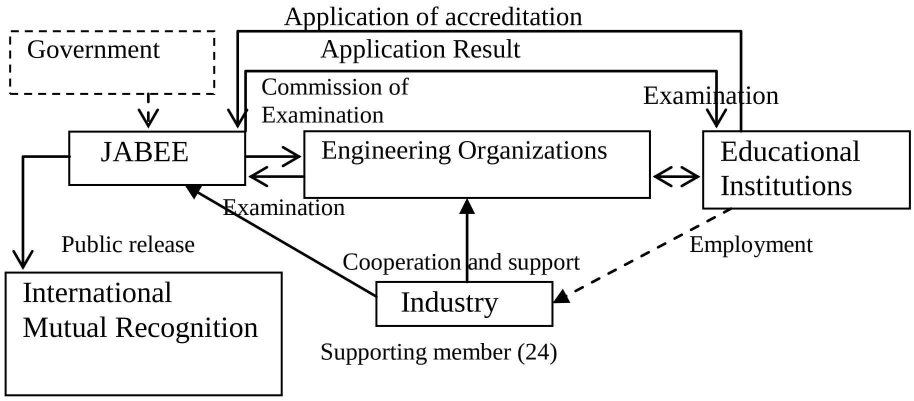


Figure 2. Relation among JABEE, engineering organizations, educational institutions and industry *(2012)*

Current Professional Engineer and *Kenchikusi* Qualification to professional engineer

Figure 3 shows the current qualification system of P.E.Jp and *Kenchikushi* in Japan. They are implemented by IPEJ and JAEIC, respectively, being administered by related ministries as mentioned above.

Qualifying examination for PE.Jp

The 1st-Stage P.E. exam is only written one and is conducted in 20 technical disciplines to judge whether or not an applicant has the general basic engineering knowledge of engineering science and specific engineering knowledge of the specified technical discipline required to become a P.E.Jp.

I. General basic knowledge of science and technology : 1hour
II. Professional ethics: 1hour
III. Common basic knowledge of the two subjects that the applicant has selected, in advance, out of five subjects: of mathematics, physics, chemistry, biology and geology: 2hours
IV. Specialized basic and specialized knowledge of one discipline that the applicant has selected in advance, out of 20 technical disciplines: 2hours

The 2nd-Stage P.E. exam consists of written and oral examinations. Applicants should take two kinds of exams; one is for elective exam in order to assess the applicant's professional competence (knowledge and skills) necessary for works of the selected subject. Here they write the answer to three questions chosen from six in the selected subject in 3 and half hours in the form of a thesis. The other is compulsory one to assess an applicant's ability for logical thinking and solving problems on works of the overall range of selected technical discipline. Here they write the answer to two questions in the selected subject in the form of a thesis in 2 and 1/2 hours.

An applicant who passed the written exam takes the oral exam and is to submit prior to it an Engineering experience report of A4 sized paper within 2 pages, less than 3000 Japanese characters including drawings, with black and white color. Contents of the report for the Technical Disciplines are of the applicant's "expertise matters". In the interview, which is conducted referring to the applicant's engineering experience report and its resume submitted prior to the oral examination, following points are examined. 1) Experience and competence, 2) Systematic expertise knowledge, 3) Insight on technology, 4) Ethics for Engineers, 5) Understanding of PE system and others

Qualifying examination for 1st-class *Kenchikushi*

The qualifying examination consists of the "academic subjects" and the "designing and drawing";

Academic I (planning and design): Architectural planning design, environmental engineering, building equipment and service, etc;

Academic II (regulations and related laws): Building standard law, Kenchikushi Law, etc;

Academic III: structural dynamics, general structure of building, building materials, etc;

Academic IV (Construction): building construction, building estimate, etc;

Those who have passed examination in the academic subjects shall be exempt from it for a limited period of time. For 1st-class *Kenchikushi*, the limit shall be one fiscal year.

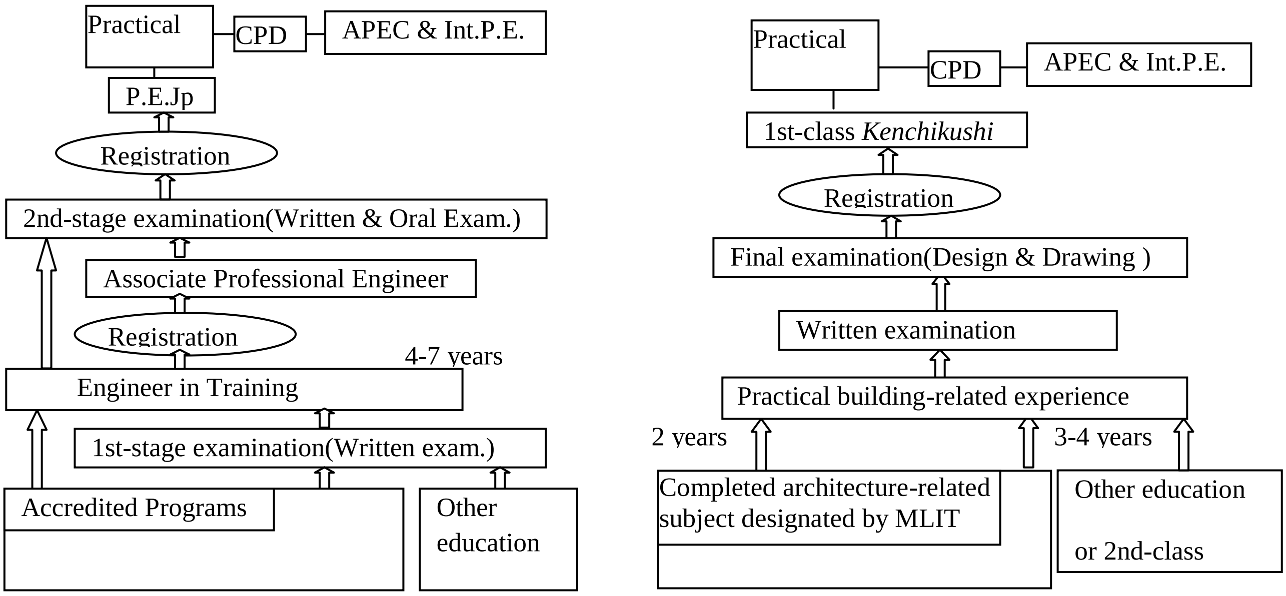
The final examination is on design and drawing of arrangement plans, plan of each floor, section (each 1/200), floor square chart by, etc.

Continuing Professional Development (CPD)

Both P.E.Jp and *Kenchkushi* are requested to continuously improve the competences of professional engineer by the amendment of the related laws in 2000. In response to the amendment, IPEJ implemented CPD and defined the purpose of CPD as follows: Every professional engineer shall continue his or her professional development with an emphasis being place on the following points:

- Awareness of engineering ethics;
- Contribution to advance in science and technology;
- Adaptation to changes in social environments;
- Improvement of ability of judgment as professional engineer.

It is desirable for each professional engineer to carry out CPD programs 50 hours/annually, 150 hours within three years (in case of APEC engineer, 250 hours within 5five years). (CPD hours are obtainable by multiplying the number of hours actually spent for CPD by a weight factor).



(a) P.E.Jp (b) *Kenchikushi*

Figure 1. Qualification system of professional Engineers in Japan

Current Problems

As mentioned above, Japan has developed the engineering qualification system including accreditation system of engineering education which is substantially equivalent to the Washington Accord member economies and has hoped to increase the number of professional engineers with good education and training. However, we have the following problems now;

1) The concept of PE is still not so popular. Although the number of professional engineers is increasing as shown in Figure 3, the number is much lower than expected. This is mainly because they don't feel much benefits of PE including APEC engineers except construction and civil engineering as mentioned above.
2) The number of registered APEC engineers is decreasing recently as shown in Figure 4.
3) Mobility of engineers is still small.
4) The number of accredited programs is saturating. The reasons are as follows:

- The people in higher education think that the institutional accreditation is sufficient enough and do not understand the necessity of the program accreditation. The institutional accreditation became mandatory since 2004 for every higher education institution. The purpose and effect of these two accreditations are different and independent. Faculties still do not understand the meaning of program or professional accreditation.
- They say that we don't care about quality assurance of the minimum level.
- Accreditation hinders progress because of stiff regulation and control.

These are a kind of misunderstanding and now JABEE is encouraging to change the current education with asking to show evidence together with outcomes evaluation when they have been keeping the conventional education.

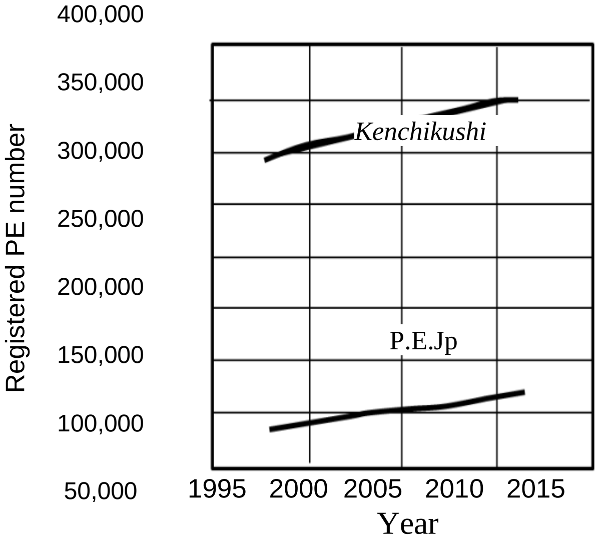


Figure 3. Change in numbers of registered P.E.Jp and Kenchikushi

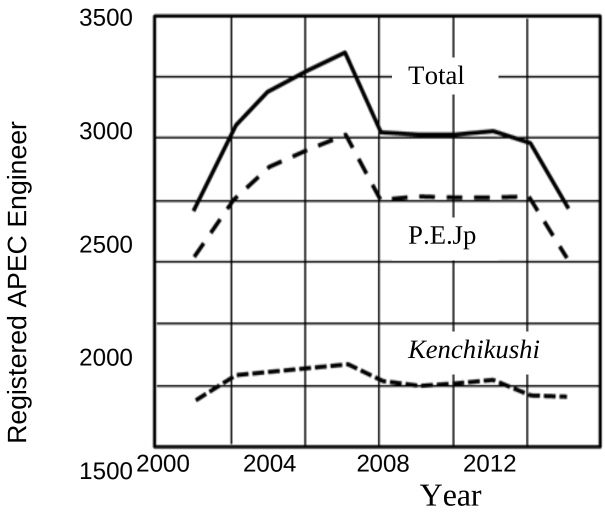


Figure 4. Change in number of registered APEC engineers

Concluding remarks

The most important role of professional engineer system is to provide trustworthy professionals to realize safety and economical society. Although it is sure that engineers have responsibilities for that, safety cannot be realized without other people such as corporate executives and/or government, clients who have the right to make decision. We need to take holistic approach to realize safety. In my opinion it is education. Further, solving global problems such as global warming and energy, natural resources, etc we need a lot of international cooperation. Not only the professional knowledge such as engineering science but also communication and networking skills among various people, and modesty to the nature are very important to avoid the defects caused by the professionals who are called *Savage in Civilized Society by J.Ortega y Gasset* about 80 years ago[2].

References

[1] http://www.apec.org/Meeting-Papers/Leaders-Declarations/1995/1995_aelm.aspx
[2] J.Ortega y Gasset; La Rebelion de las Masas, 1930

The Role of the System for Engineers Certification in Russia in Development of the National Concept for Engineering Education

(Prof A.Ch. Erkenov, Deputy of the Russian Federation State Duma, Member of the Committee for Education)

First of all, on behalf of the State Duma Committee on Education, I should like to take advantage and to greet all participants of our seminar and to wish health, happiness in their personal lives and success in work.

The purpose of our seminar is the exchange of experience among the economies-participants of the APEC Engineers Register in the field of regulation of engineering activity, increase in professional mobility of engineers, and overall improvement of engineering education. International APEC Engineer Register is created within the organization of Asian-Pacific economic cooperation (Asia - Pacific Economic Cooperation, APEC) with the purpose of development of economy, trade and investments in the Asian-Pacific region. APEC includes 20 economies, including the USA, Canada, Australia, New Zealand, Japan and China. Registration of engineers in APEC Engineer Register confirms recognition of their status of the professional engineer and increases competitiveness on the international labor market.

On the threshold of the meeting of leaders of APEC economies on the Russky Island (Vladivostok) in September 2012, we organized a series of significant events for APEC economies in a number of Russian cities. These actions included the international seminar “Preparation of engineers in APEC economies”.

The problem of preparation of engineers is topical for the Russian Federation. It is worth mentioning that the Association for Engineering Education of Russia (RAEE) was included in the APEC Register of engineers. Tomsk Polytechnic University (TPU) is the first in the Russian Federation that has the right to carry out certification and registration of professional engineers using the APEC system. It also conducted certification of Russian experts; according to the requirements, the graduate of the accredited program should work certain time in a preferred field in a supervising position, be engaged in project work, continuously raise the qualification and to pass certified examinations. As we see, requirements are high but quite realizable.

Nowadays many experts define two steps of engineering education quality. The first step is public and professional accreditation of educational programs. The second is certification and registration of engineers. In our economy the Association for Engineering Education of Russia is engaged in public and professional accreditation of engineering educational programs. Today 25 Russian universities have 150 accredited programs. In 2008, graduates of these programs received the right to get in the register of the European engineers.

Engineering education is very specific since we have to take into account the present-day situation when almost 100 % of Russian secondary school leavers apply for university. Partly, such increase in availability of university education results in decrease in its quality. In Russia secondary school graduates with different levels of academic knowledge have identical matriculation certificates while the program of training is different, which later causes non-equivalence of academic qualifications obtained in different educational institutions. Besides, the demographic wave shows reduction of the number of potential students. In five years the labor market is likely to see fewer engineers, which means that graduates of technical universities should become elite experts; otherwise Russian economy might face unexpected hardships.

To become a certificated APEC specialist, it is necessary to have a seven-year period of practical work upon graduation from university, including two years of project management, and only then to confirm the obtained knowledge and experience.

The distinctive feature of the registration system for engineers is the fact that the certificate has its expiry date, which compels its owner to undergo re-registration periodically. At the same time, it implies obligatory annual improvement of professional skills, which, in its turn, initiates the whole system of support of the "all life training" model backed up by relevant standards of the registration system.

Considering specific features of preparation and certification of technical specialists, I believe that the role of RAEE should increase and obtain the status of public and state partnership. Simultaneously it is necessary to take urgent steps in developing the concept of the doctrine of engineering education.

We plan to present the first variant of the concept at the beginning of December, 2012 in Tomsk at the national scientific conference "Approaches to development of the national doctrine of engineering education in the conditions of new industrialization".

Session: DEVELOPMENT OF PROFESSIONAL ENGINEERING ELITE

IN APEC ECONOMIES

Experience in the Regulation of Professional Practice in the Philippines

(Engr Federico A. Monsada, Philippine Technological Council, President)

Abstract

Engineering education and engineering practice in the economy have been transforming towards becoming more and more global in the last five to ten years.

In this regard, the system of engineering education has been continually reviewed by various composite teams of experts from the industry, government, and the academe driven mainly by the singular purpose of improving the quality of academic preparations of engineering graduates for entry to the practice of the profession. With the above reality of engineering practice becoming more global, both government policy-making and regulatory bodies and the higher educational institutions (HEIs) are continually faced with the need to pursue policy reforms and development programs, respectively, to enhance educational delivery administration and educational outcomes. Two of these policy reforms and development programs that have been receiving considerable attention from the various stakeholders are the twin programs of implementing outcomes-based educational system among HEIs and the adoption of an independent, industry-led outcomes-based accreditation system for engineering education programs benchmarked against known international standards.

Engineering practice, on the other hand, has always been regulated by the state for a number of professional disciplines since the early 1950s. Today, there are twelve such professional engineering disciplines regulated under the corresponding professional engineering laws each one covering, among others, the traditional disciplines of mechanical, civil, electrical, electronic, chemical, mining, metallurgical, and aeronautic engineering. Industrial, materials, ceramic, computer, and petroleum engineering disciplines, while currently being practiced in the economy, are not among those covered under the state regulation regime. To enter the practice of the regulated profession, the graduate engineer must pass a state licensure examination in his chosen field of practice. The licensure examination is administered by the respective professional regulatory board created and mandated under the specific professional engineering law.

During the last few years, licensed engineers have been required to undergo continuing professional education with specified number of required attendance units to maintain currency of their licensing and registration status. Tripartite councils comprised of representatives from the academe, the professional regulatory body, and the professional societies, have been created for each professional engineering discipline to

assure compliance with the requirements for continuing education. Furthermore, recognition of professional engineers' qualifications under the APEC and the ASEAN registries has already gained momentum as an accepted mechanism to benchmark one's qualifications against international standards and, in the process, gain competitive advantage and professional mobility.

This paper deals with the experiences in engineering education and engineering practice in the jurisdiction to achieve and maintain globally-competitive graduate and professional qualifications. Latest developments are presented together with a short discourse on the involvement and role of the professional engineering bodies in continually bringing about the creation of an engineering elite that is globally-competitive and professionally mobile yet focused in achieving a truly sustainable socio-economic development for humanity.

Context of Engineering Education and Practice

The first known conferment of engineering degrees (MS in Civil Engineering) was made exactly a hundred years ago in 1912 at the Faculty of Engineering of the University of Santo Tomas, the oldest engineering school in the economy. Since then hundreds of thousands of engineering graduates have finished their engineering programs from about 500 or so tertiary-level engineering institutions, majority (around 80%) of whom are privately-owned and funded. Today a total of around 300,000 students are enrolled at any time in these local institutions with some 30 thousand students finishing their programs annually with mostly baccalaureate degrees and some with advanced degrees such as masters (about 300) and doctorate (10-20). Some engineering graduates pursue their masters and doctoral degrees in foreign universities in the US, Australia, Japan, Europe, among more popular destinations. At present there are around 15 specific engineering degree programs being offered by higher educational institutions (HEIs) with the traditional disciplines of civil, mechanical and electrical engineering constituting the most number of enrolees and graduates.

Tertiary and graduate education, of which engineering education is a major sector, is being supervised by the Commission on Higher Education (CHED), one of three governing bodies involved in the education sector, the Department of Education being in charge of the basic education (pre-school, primary and secondary) and the Technical Education and Skills Development Authority (TESDA) for technical-vocational and middle-level education. The creation of CHED in 1994 was part of a broad agenda of reforms on the economy's education system outlined in 1992. It is an agency directly attached to the Office of the President charged with formulating plans, policies and strategies on higher education in the economy.

Higher education in the economy, particularly private higher education, is a closely regulated industry. Private institutions must obtain permits from the CHED to be able to offer new educational programs. The final recognition of the new programs is granted only after three years of operation.

Engineering Programs

Engineering programs were designed to be completed within four (4) years or eight (8) semesters of academic work until the school year 1954-1955. Since then the 5-year bachelor programs were adopted and were mandated to incorporate social sciences and humanities subjects in the curriculum, all for the intent of producing a more rounded graduate engineer. The 5-year program since then typically consisted of the first 2 years of general education with mandatory coverage, which has been adopted for all engineering programs, and the last 3 years of technical specialization courses. Industry internships of about 360 hours were added in some, if not, most of the programs, to allow smoother transition from the academe to the industry practice. Entry to the program under the two educational regimes remained substantially the same, i.e., one was required to complete satisfactorily the 6-year elementary and 4-year secondary education, and in some institutions, passing admission examinations.

To support its regulatory and development missions, CHED has been regularly tapping the volunteer services of technical panels and committees (Technical Panel for Engineering and Technology or TPET, and, Technical Committees) composed of experts from various fields of engineering and from the academe, industry and government, to review the minimum standards for educational programs and institutions. Reviews were generally focused on curriculum and the educational delivery infrastructures to support the educational programs.

In the early 2000, reviews of the curricula of the various engineering disciplines were initiated by CHED through the above technical panels and committees. As a result of these reviews, CHED Memorandum Orders (CMOs) were issued for each of the engineering programs which incorporated revisions in the overall framework for engineering education and a number of major revisions in the various curricula. The author was involved in one of these panels and technical committees – the Technical Committee on Metallurgical Engineering.

The Coming of Outcomes-Based Education

One of the very notable changes observed in the CMOs issued was the incorporation into the guidelines of some elements, e.g., program outcomes, target competencies for the program, among others, of what eventually would be generally known as outcomes-based educational framework. Likewise, curriculum mapping was adopted during those times whereby courses/subjects were individually mapped against the various program outcomes. It is worthwhile to note that, at that time, the Engineering Criteria 2000 of ABET, Inc. was already known in the education world, thus, it was not surprising that the program outcomes in the various CMOs were substantially adopted from ABET's.

The CMOs stipulated the minimum standard requirements for each of the engineering programs being offered by the institutions. The institutions are continually monitored as regards their compliance with these requirements.

Quality Assurance Framework and Accreditation for Engineering Education

Quality assurance system for higher education in the economy has been substantially provided by the CHED, the accrediting agencies, and the Professional Regulation Commission.

CHED has developed and implemented its own institutional and program quality assurance through the technical panels and technical committees. Consistent with its own quality assurance system, CHED has granted status of “Center of Excellence” or “Center of Development” to institutions and specific programs, which have surpassed not only the minimum requirements of an institution offering a particular program but have also demonstrated distinguished performance as regards its program offerings.

The educational accrediting agencies, on the other hand, have been undertaking voluntary accreditation of institutions and programs since some 50 years back, however, the accreditation of engineering programs were started only in the 70s to the 80s. The said agencies developed their accreditation standards for programs that exceed the minimum requirements imposed by the government regulatory bodies in the economy. Their accreditation works have been recognized by the government in the various CMOs of 1995 and, further, in 2005.

The voluntary accreditation system in the economy is patterned significantly after the US model of accreditation. Accreditation is both institutional and program-based. However, there have been existing structural/conceptual features in these accreditation systems that prevent the jurisdiction easy entry into international accreditation aggrupation such as the Washington Accord. Firstly, while Washington Accord provides for leading participation of engineering professional bodies in accreditation, the above accreditation system have been run by non-engineering professional bodies. Secondly, whereas all Accord members have accreditation systems that are independent of the higher educational institutions offering engineering programs, the existing accreditation bodies have schools as members and send out accreditation teams composed solely of academics wearing the hats of their respective schools. Lastly and most importantly, while Accord members subscribe to the outcomes-based approach to assessment and evaluation, the existing accreditation systems have invariably been more bean counting of inputs to the programs.

The Professional Regulation Commission (PRC) is the government body whose main mandate is to implement the “promotion and sustained development of a reservoir of professionals whose competence has been determined by honest and credible licensure examinations and whose standards of professional service and practice are internationally considered world-class brought about by the regulatory measures, programs and activities that foster the professional growth and advancement" of the professionals. PRC is responsible for all the administrative matters pertaining to the implementation of the various professional laws governing the various professional engineering disciplines. One of its major functions that impact on the entry of graduate engineers into the practice of engineering is the administration of licensure examinations conducted through the various professional regulatory boards corresponding to the various professional engineering disciplines. Licensure examinations are intended to measure and assure the readiness of the graduate engineer to enter the practice of the profession. A graduate engineer upon passing the licensure examination is bestowed the license to practice his profession, however, subject to the code of ethics imposed on professionals by the PRC and the professional organization to which the professional belongs.

In the last few years, licensure examinations, while considered an end-of-the pipe quality assurance mechanism, has been considered to be effective in contributing to the regulation of the practice of the professions. Of the total annual number of engineering graduates in the last few years, about 75% are estimated to have taken the licensure examinations, and, generally, about 50% of this number passed the examinations and allowed to enter the practice of the profession.

Engineering Practice

Professional engineers have been mainly employed in the manufacturing, food, construction, semi-conductor and electronics, engineering services, energy, and the mining and metals industrial sectors. With the opening up of the ASEAN Economic Community in 2015, these sectors are expected to boost further the demand for engineering services not only from among the region's industries but even from those non-ASEAN entities who are preparing to provide services to or invest in the region.

With the advent of ASEAN 2015, national boundaries will be opened to cross-border practice. Regulatory reforms are expected to be forged and implemented among the ASEAN economies in due time, if only to allow the full implementation of the provisions of the various mutual recognition arrangements underpinning the implementation of the ASEAN 2015. One of these arrangements is the Mutual Recognition Arrangement on Engineering Services, which provide for the mutual recognition and assessment of qualifications of engineering professionals to be able to provide engineering services across national borders.

A significant number of Filipino engineers have been practicing engineering in various parts of the globe especially in the Middle East, in the Americas and in Asia for some time now. Engineers have been working in the food, oil, manufacturing, manufacturing operations, electronics, construction, engineering services sectors, among other practice areas, in these jurisdictions. The author does not expect decline in the temporary migration by engineering professionals in these sectors and jurisdictional areas in the next few years.

However, the increasing demand for engineers and the need for global quality of engineering works in these areas of professional practice, have triggered inquiries from professional engineers for qualifications assessment and recognition such as those implemented in the various registers such as the APEC Engineer Register, the ASEAN Engineering Register, and the like. This is invariably the trend and the direction to choose in order to increase one's professional mobility in the global practice of engineering.

Legal Bases of Engineering Practice in the Economy

Engineering practice in the economy is governed by the various laws that correspond to each of the professional engineering disciplines requiring licensing and registration.

Currently there are twelve professional engineering disciplines covered by these laws, which include, among others the following:

1. Aeronautical engineering
2. Agricultural engineering
3. Civil Engineering
4. Chemical Engineering
5. Electrical Engineering
6. Electronic Engineering
7. Geodetic Engineering
8. Mechanical Engineering
9. Metallurgical Engineering
10. Mining Engineering
11. Naval Architecture and Marine Engineering, and
12. Sanitary Engineering

Graduates from the above engineering programs are required to take and pass the licensure examinations prior to their being allowed to practice their profession.

On the other hand, graduate engineers from other engineering programs such as computer engineering, industrial engineering, ceramic engineering, materials engineering, environmental science and engineering, petroleum engineering, among other programs, may practice their profession subject only to existing qualification schemes and ethical standards set by their respective professional organizations and other qualifies bodies not necessarily regulatory.. Regulatory legislations are not expected to be crafted for these disciplines in the future unless these are found necessary to foster public health, safety and security.

Continuing Professional Education

Graduate engineers who passed the licensure examinations are emplaced and registered in the roster of professional engineers in their respective fields of practice. To maintain the currency of their registration, professional engineers are required to undergo continuing professional education (CPE) with at least 60 units over a period of three years, prior to re-registration at the end of the 3-year period. This requirement for continuing professional education is mandatory for a number of engineering disciplines, e.g. civil engineering, mechanical engineering, electrical engineering, and electronic engineering, while it is only an adopted requirement for the others. With the Professional Regulation Commission's issuance of an order, in accordance with its regulatory and promotion mandate and functions, the CPE scheme became substantially mandatory and should eventually be implemented across all professional engineering disciplines.

To ensure the compliance of professional engineers to this requirement, the PRC established for each professional discipline, a CPE Council composed of one representative each from the appropriate professional regulatory board, the academe, and the professional organization. The function of the CPE Council is to ensure that the CPE Scheme is implemented and that the record of compliance of each professional engineer is properly maintained and continually updated.

Professional Engineer Recognition

A number of the professional engineering laws, such as those of the mechanical, electrical, and the electronic engineering, provide for the recognition of professional expertise and competencies at independent practice level. Upon assessment and evaluation by the appropriate professional regulatory board and upon the endorsement of the corresponding professional organization, an engineer maybe bestowed the title of "Professional Mechanical Engineer", or "Professional Electrical Engineer", or "Professional Electronic Engineer", as the case maybe.

The assessment mechanism and the criteria adopted by the various professional disciplines in assessing and evaluating the qualification of candidates for the above recognition were substantially benchmarked against international standards such as those of the APEC Engineer Register and the ASEAN Engineering Register, among others. In the case of "Professional Electronic Engineer", the assessment mechanism and criteria were closely patterned after those of the APEC Engineer Register.

Mutual Recognition Arrangement and Reciprocity

The Philippines is a major party to the ASEAN economic grouping which is due to fully implement the integration of the ASEAN's ten economies into one big production and marketing base by 2015. One of the major support mechanisms to realize this integration is the implementation of the Mutual Recognition Arrangement (MRA) on Engineering Services which provides, among others, the mechanisms for the assessment and recognition of engineer's qualifications and the subsequent entry into the register of engineers for the eventual purpose of cross-border practice.

Other than the above MRA for Engineering Services, the economy has not entered into similar arrangements, bilateral or multi-lateral, at the moment, that may impact substantially on the practice of engineering in the economy.

It is noteworthy though that the various laws governing the practice of the various professional engineering disciplines allow practice of engineering in the economy subject only to the "reciprocity" arrangements that may exist between the economy and other sovereign state. This provision in most of the professional engineering laws, of course, is not without prejudice to the domestic requirements for passing the licensure examinations prior to practice, as maybe applicable.

New and continuing developments impacting engineering education and practice

The increasing trend in professional practice across national borders brought about by bilateral and multilateral agreements such as the ASEAN Economic Community in 2015 has put a lot of pressure among education and professional regulators, educators and professional bodies to work together in crafting policies and pursuing development programs that will continually produce graduate engineers who are internationally mobile and whose academic qualifications and attributes are benchmarked against international standards. Likewise, the professional organizations have been playing very significant role in raising and maintaining the bar of professional and ethical qualifications of engineers.

In pursuit of the above, the various stakeholders in tertiary level engineering education and practice, the industry and the government in the economy have been working jointly and severally to bring about reforms and much needed development in both engineering education and practice. Major policy changes are being sought and programs are being implemented in all areas of the educational systems as well as in practice.

The overall relationships of these various efforts may be schematically represented as shown below (Figure 1).

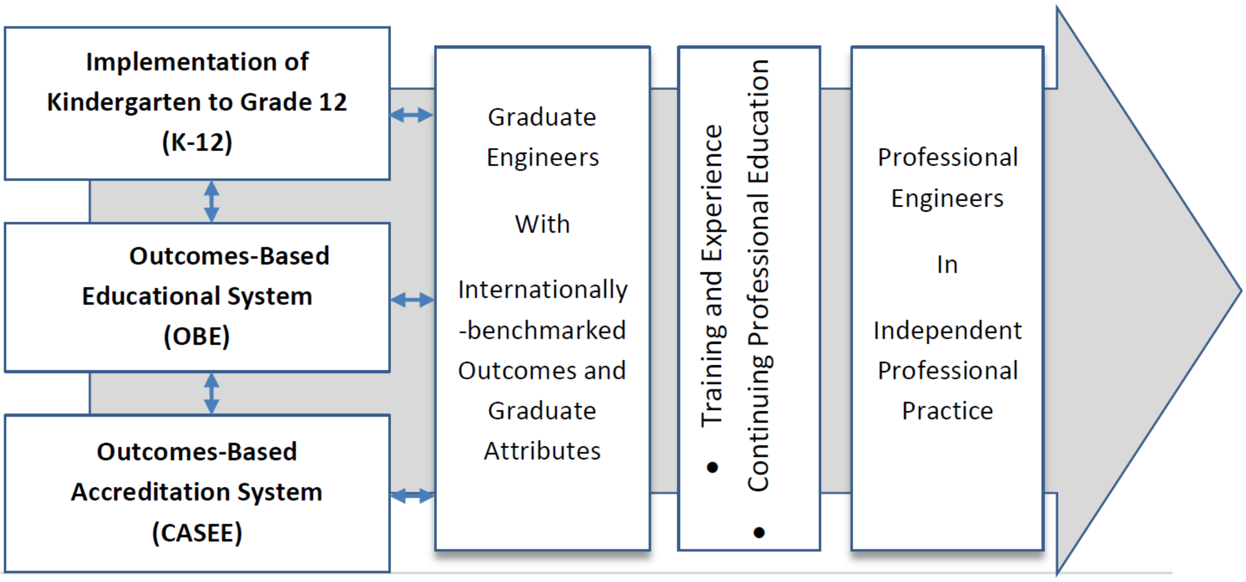


Figure 1. New and continuing developments impacting engineering education and practice

Engineering Education Development Programs

Outcomes-based Education. CHED and the Technical Panel for Engineering and Technology/Technical Committees (TPET/TC) on various engineering disciplines regularly review the various CMOs pertaining to each of the engineering disciplines, which practice are either regulated on non-regulated, every five (5) years. The general review cycle is currently on-going. Curriculum revisions are afoot to align its components to the OBE.

Likewise, CHED has recently reactivated and reformed its Technical Working Group on Outcomes-based Education (TWG-OBE) composed of representatives from the academic community, the Philippine Technological Council, and the government to plan, develop and pursue the implementation of Outcomes-based Education (OBE) in the higher educational institutions.

Training and road-shows for the implementation of OBE are on-going and are expected to go on full course within the year. The first five-year activities under the program are expected to be completed by 2016, by which time, a significant number of HEIs will have instituted OBE in their engineering programs. Likewise, it is expected that they will be seeking accreditation of their programs to internationally-benchmarked accreditation by then.

The OBE program is a twin of the Outcomes-based Accreditation System Implementation Program discussed hereunder.

Human Resource Development. To further strengthen the faculty base of the various educational institutions in the Engineering Research and Development for Technology (ERDT) was established. The ERDT is a consortium of seven universities in the economy that offer mature master`s and doctoral degrees in various engineering fields: University of the Philippines-Diliman, De La Salle University, Mapua Institute of Technology, Ateneo de Manila University, Mindanao State University Iligan, University of San Carlos, and Central Luzon State University. ERDT Funding comes from the Department of Science and Technology.

“The components of the ERDT program include local MS and Ph.D. scholarships, foreign doctoral scholarships for faculty members, visiting professors, post doctoral fellowships, infrastructure development, and research and development (R&D) in four areas: ICT, Semiconductor and Electronics, Energy, Environment and Infrastructure. In 7 years' time, the number of RSEs in the economy will triple and the R&D spending as a percentage of the GDP will be 0.5%.” (Source: *Aura Matias, Ph.D, Dean University of the Philippines College of Engineering)*.

Quality Assurance and Accreditation of Engineering Program.

The Philippine Technological Council (PTC), the umbrella organization of thirteen engineering professional organizations each representing the respective engineering professionals in the economy, has developed and is currently implementing an independent, voluntary, engineering professional-led accreditation system called the Certification and Accreditation System for Engineering Education (CASEE) since 2009. Recognized by the CHED as the sole accrediting agency for engineering programs to international standards, PTC organized the Accreditation and Certification Board for Engineering and Technology (ACBET) to implement its accreditation policies and procedures.

Substantially outcomes-based, CASEE is patterned from ABET’s accreditation system, however, with adaptations made for local conditions. CASEE was developed with participation and/or consultations from the industry, the professionals, the academe, the existing accrediting bodies (for their long-standing accreditation expertise), and the government. While CASEE was developed cooperatively, the ownership of CASEE, its implementation and continuous improvement remains exclusively with PTC.

CASEE review cycle 2012-2013 is currently on-going. With CASEE and its subsequent continuous improvement, PTC is currently preparing to seek membership with Washington Accord and contribute to the enhancement of the mobility of the jurisdiction’s graduate engineers in the near future.

Engineering Mobility and Practice

The Professional Regulation Commission maintains the national rosters of professional engineers for the various engineering professions. Working together with PRC and the professional regulatory boards (PRB), the professional engineering organizations (PEO) have been working to enhance further the qualifications and competencies of its professional members through continuing professional education (CPE) and increase their mobility.

PTC, on the hand, representing the PEOs, have applied for and has been granted the membership to various mobility forums and have been allowed to maintain engineering registers such as the APEC Engineer Register (2003) and the ASEAN Engineering Register. Currently it is working very closely with APEC Engineer Register National Monitoring Committee (composed of PRC, CHED and PTC) to further enhance the value of APEC Engineer to its professional engineers.

The ASEAN Chartered Professional Engineer Register (ACPER) which is formed and being implemented under the Mutual Recognition Arrangement (MRA) for Engineering Services under the ASEAN Economic Community 2015 is expected to be fully implemented in the economy within 2012 and to be managed by the same tripartite monitoring committee as that of the APEC's. With the ACPER assessment statement substantially patterned after the ASEAN Engineering Register's and, to some extent, the APEC Engineer Register's, the three taken together make good a benchmark for the economy's engineering professional qualifications assessment.

PTC working with PRC and other stakeholders will continue to enhance the administration of the registers and enhance its value to the professional engineer.

K to 12 Basic Education Model and Implementation

Education up to high school is free except for those who choose to enrol in privately run institutions. Primary and secondary education generally consists of 6 years and 4 years, respectively, of schooling. A number of private institutions, however, offer Grade 7 in elementary.

To further enhance the preparedness of students graduating from high school to pursue higher education and/or enlist in the workforce, the government through the Department of Education will be implementing the K to 12 program effective this 2012. The K to 12 program seeks to provide a 12-year basic education to all Filipinos instead of the 10-year basic education as previously practiced.

It is expected that with the K to 12, Filipino students will be better prepared in terms of knowledge, skills and competencies to pursue higher education and gain international recognition both as a student and, eventually, as a professional. In the K to 12 model, the 2 years for senior high school is aimed at giving the students time to strengthen these knowledge, competencies and academic skills. Depending on the occupational or the career track student chooses, the curriculum will also provide specializations in the following: science and technology, music and arts, agriculture and fisheries, sports, business and entrepreneurship, etc, There is an emphasis on lifelong learning to build on these skills depending on their chosen field.

Conclusions

The continuing development of a body of professional engineers whose qualifications and competencies measure up to international standards is, indeed, a tall order and a daunting task.

The engineering professional lifecycle does not begin only when the prospective engineer enters the educational institution of higher learning but the preparation extend way before, during the professional's primary and basic education years.

The stakeholders of the various engineering profession realize that to produce a body of truly global, competitive, qualified and internationally mobile professional engineer requires ardent preparations on the part of the educators, the education regulators, the professional engineering bodies, themselves, and the industries who will take on the task of providing the avenues for further professional development of the graduate engineer.

The stakeholders of engineering education and practice in the economy are continually taking cue from those who led in these endeavours while they also ensure that appropriate local practices are adapted into all programs and policies.

The Philippine Technological Council, being the focal point of the various advocacies of engineering professionals in the economy, is in the midst of all of these. And to effectively do this its daunting task, PTC continually seek to network with its fellow professional engineering bodies around the world and benchmark its practices as regards engineering education and practice.

While PTC hopes to achieve international recognition of its professional engineering members in due time, it also hopes to primarily share the advocacy that engineering can either be a boon or a bane to humanity. Engineering for humanity is it!

Development of Engineering Education considering the International Criteria of Accreditation and Certification

(Prof A.I. Chuchalin, Accreditation Board Chairman of the Russian Association for Engineering Education, Vice-rector of Tomsk Polytechnic University)

The improvement of quality of engineering education is a challenging task in order to implement the strategy of economy modernization and technological development. It is important to develop the best traditions of national engineering education with regard to international standards for engineering profession.

International standards for quality of engineering programs are defined today by two reputable organizations: Washington Accord (WA) and European Network for Accreditation of Engineering Education (ENAEE).

Today WA unites accrediting agencies of 14 economies as full members and 6 provisional members, including Russian Association for Engineering Education (RAEE).

In 2006 in Europe in light of the Bologna Process ENAEE was founded. The Russian Association for Engineering Education has been a founding member of ENAEE. ENAEE authorized the accrediting organizations of 7 economies: Germany, France, Great Britain, Ireland, Portugal, Turkey and Russia (RAEE). Engineering organizations of Spain, the Netherlands, Italy, Switzerland and other European economies plan to join ENAEE.

Since 1992 RAEE has been participating in development of the national system for professional accreditation of engineering programs in Russian HEIs. In 2002 RAEE Accreditation Center and RAEE Accreditation Board were established. The RAEE activity on developing the system for professional accreditation is supported by the RF Ministry of Education & Science, Russian Chamber of Commerce & Industry, Russian Academy of Education, Russian Academy of Science, Russian Union of Scientific & Engineering Associations, etc.

By the year 2012 more than 200 of HEIs engineering programs in Russia and Kazakhstan have been accredited by the RAEE Accreditation Centre, including those accredited with EUR-ACE Label awarding.

The RAEE Accreditation Center criteria for evaluating the engineering programs are based on the best practice of the national higher education and consider the world experience in engineering education quality assurance focused on the competence and learning outcome approaches.

At present, Russia is entering a new stage of higher education modernization caused by development and introduction of the new Federal Educational Standards of the third generation and mass transition to two-cycle system of higher education: FCD - Bachelor

(4 years) and SCD - Master (2 years). Thus, there are likely to be changes in the Russian system of engineering education, i.e. reduction of the study period at HEIs by one year (transition from 5-year Specialists' programs to 4-year Bachelors' programs in 60 out of 100 engineering disciplines), which is the subject of many debates.

In 2009 the RAEE modified the criteria for accreditation of engineering programs taking into account the new Federal Educational Standards and considering the membership in international organizations (Washington Accord and ENAEE).

The changes resulted in elaboration of the new set of the working documentation (the outcome-based criteria and accreditation procedure, self-study manuals, expert guidelines) compatible with those existing in the Washington Accord signatories and ENAEE members.

For the time being the RAEE accreditation criteria are grouped as follows:

1. Program Objectives (formulated based on the main consumer demands and agreed with the HEI's mission, Federal Educational Standards, shared by the engineering community and open for all stakeholders).

2. Program Content (sets the requirements for the content of the academic program: a program should hold firmly stated learning outcomes agreed with program objectives, satisfy the requirements for the curriculum structure and for the correlation between the volumes of disciplines cycles).

3. Students and study process (sets the requirements for the learning process and student contingent: study process should ensure the possibility of achieving the learning outcomes by every graduate; the program should possess the tool for continuous control of performance and the feedback for its improvement).

4. Faculty (sets the requirements for the teaching staff ensuring the delivery of the educational program, the level of its qualification; participations of the teaching staff in the pedagogic and scientific research & development).

5. Professional qualification (sets the requirements for the learning outcomes – knowledge, skills and experience that student should possess to the moment of graduation: each learning outcome should ensure the achievement of at least one program objective and should be measurable).

6. Facilities.

7. Information infrastructure.

8. Finance and management (set the requirements to the resource base of the program: available resources should correspond to program objectives and ensure the learning outcomes achievement by every graduate).

9.Graduates (sets the requirements for the HEI' communication with graduates: in HEI the system for analysis of employment, demand, career coaching and continuous professional development of the graduates should be used for further upgrade of the academic program).

The RAEE modified Criterion 5 supposes that a Bachelor (a graduate of the FCD program) should be mainly trained for complex engineering activity, while both a Master and a Specialist (the graduates of the SCD programs) should be focused on innovation in engineering and technology.

Table1. The RAEE Criterion 5 for FCD and SCD Engineering Program Graduates

1.2. Engineering Analysis	
Identify and solve the problems of complex engineering analysis applying comprehensive knowledge and modern analytical methods and models.	Identify and solve the problems of innovative engineering analysis in the conditions of uncertainty applying in-depth knowledge, analytical methods and complex models.
1.3. Engineering Design	
Design solutions for complex engineering problems applying comprehensive knowledge and methods to achieve the optimal results to meet defined and specified requirements.	Design solutions for innovative engineering problems applying in-depth knowledge and original methods to achieve the advanced results in the conditions of uncertainty.
1.4. Investigation	
Conduct investigations of complex engineering problems including information search, experiment, and data interpretation applying comprehensive knowledge and modern methods to achieve required results.	Conduct investigations of innovative engineering problems in the conditions of uncertainty including critical analysis of data, complex experiment, interpretation and decision making applying in-depth knowledge, original methods to achieve required results.
1.5. Engineering Practice	
Select and use appropriate resources, equipment and tools for complex engineering practice taking into account economical, environmental, societal	Create and use appropriate resources, equipment and tools for innovative engineering practice taking into account economical, environmental, societal

aspects and other limitations.	aspects and other limitations.
1.6. Specialization and labour market orientation	
Be prepared to invest knowledge, skills, time and effort for complex engineering activities as required by potential employers and follow their corporate culture.	Be prepared to invest knowledge, skills, time and effort for innovative engineering activities at enterprises and companies that are potential employers and follow their corporate culture.
2. Transferable and personal skills	
2.1. Project and Financial Management	
Apply comprehensive knowledge of project management and business practice for complex engineering activities including risk and change management.	Apply in-depth knowledge of project management and business practice for innovative engineering activities including risk and change management.
2.2. Communication	
Communicate effectively for complex engineering activities with engineering community and society at large in native and foreign languages.	Communicate effectively for innovative engineering activities with engineering community and society at large in native and foreign languages.
2.3. Individual and Team Work	
Function effectively both as an individual and as a member of a team in multidisciplinary settings, share responsibilities and capabilities to solve complex engineering problems.	Function effectively both as an individual and as a member or leader of a team and in multidisciplinary and international settings, share responsibilities for a team work to solve innovative engineering problems.
2.4. Professional Ethics	
Demonstrate personal responsibility and commitment to professional ethics and norms of engineering practice.	Demonstrate responsibility for both individual and team work and commitment to professional ethics and norms of engineering practice.
2.5. Societal Responsibility	

Demonstrate knowledge and understanding of the legal, societal and cultural, environmental and health and safety issues relevant to complex engineering practice.	Demonstrate in-depth knowledge of the legal, societal and cultural, environmental and health and safety issues relevant to innovative engineering practice.
2.6. Lifelong Learning	
Recognize the need for, and have the ability to engage in lifelong learning and professional development.	

The new RAEE requirements for Bachelor ' learning outcomes are aligned with IEA Graduate Attributes and Professional Competencies, while the requirements for Master and Specialist competencies are compatible with the EUR-ACE Framework Standards for Accreditation of Engineering Programmes.

The graduates of the RAEE accredited programs may obtain the EurIng title and be registered in FEANI Register (and further obtain European Professional Engineering Card) through the Russian Monitoring Committee of FEANI founded on the basis of RUSEA.

In 2010 RAEE formally joined APEC Engineer Register. The Russian Monitoring Committee of APEC Engineers was formed by RAEE and RUSEA. It consists of representatives of legislative and executive authorities, public and professional organizations, HEIs and research institutions.

In 2010 with the support of RAEE and RUSEA the Center for International Certification of Engineering Education and Profession was founded. Center forms the examination commissions and holds testing for applicants. Decisions of the Center's commissions are controlled by RAEE and approved by the Russian Monitoring Committees of APEC Engineers. Applicants, who passed through examinations, are awarded with certificates and listed in Russian Register of APEC Engineers. The bilingual Internet-portal was launched by the Center (http://www.ApecRegister.tpu.ru).

The Russian Register of APEC Engineers is available from the official IEA web-site (http://www.ieagreements.org/ APEC/signatories.cfm).

In accordance with the international criteria for certification and registration of professional engineers in APEC Engineer Register there are definite requirements for the applicants:

- Applicant shall be a graduate of HEI who completed an accredited engineering program.

- Applicant shall have not less than 7 years of engineering practice after the graduation.
- Applicant shall have not less than 2 years of experience working as an executive manager carrying out significant engineering projects.
- Applicant shall continuously develop professional qualification.
- Applicant shall carry out activity in accordance with the Code of Professional Ethics.

In 2010 the Center for International Certification of Engineering Education and Profession accomplished pilot project.

Among 42 applicants employed in Russian high tech companies, 27 (64%) were certified and listed in Russian APEC Engineer Register.

In 2011, 112 engineers applied for certification (ROSNEFT, Siberian Chemical Plant, RUSBURMASH, GAZPROM, etc).

Finally 32 applicants (29%) employed in chemical engineering, electrical engineering, mining engineering, petroleum engineering, etc. successfully passed through examinations.

Creating in Russia the internationally recognized national system for certification and registration of professional engineers enables to raise the status of engineer and to foster:

- The development of technical education and engineering profession and improvement of loyalty to engineering profession.
- The continuous professional self-development of practicing engineers.
- The generation of highly qualified engineering elite for national economy.
- The increase of international reputation, competitiveness and mobility of Russian engineers.

International certification of Russian engineers – graduates of HEIs ensures their global competitiveness.

The fact of HEI's graduates certification in accordance with international standards de jure can prove de facto the leading position of HEI in the national system of engineering education.

Professional accreditation of HEIs' engineering programs and certification of engineers are getting increasingly popular as tools for improvement of quality of engineering education (setting appropriate objectives for academic programs, planning learning outcomes for graduates, contributing adequate resources in teaching, etc.).

Tomsk Polytechnic University regularly introduces its academic programs to external evaluation and professional accreditation.

From 1995 to 2011 TPU submitted 45 engineering programs for accreditation to IAC (RF), GATE (USA), RAEE (EUR-ACE), CEAB (Canada) and ABET (USA).

Tomsk Polytechnic University Development Plan envisages creation of world class academic environment to generate the professional elite in engineering and technology.

It is planned that by the year 2018 nearly 50% of the TPU academic programs will comply with the "international standards".

In 2010 TPU put into action "Standards & Guidelines for Quality Assurance of Bachelor's, Master's and Specialist's training in engineering and technology".

The TPU Standards & Guidelines develop and supplement requirements of Federal Educational Standards with requirements of International Standards:

- EMF, APEC Engineer Register and FEANI requirements to the competences of certified "professional engineers",
- Washington Accord, EUR-ACE and RAEE criteria for accreditation of engineering programs.

The TPU Standards & Guidelines envisages:

- Outcome-Based Approach to design, delivery and quality assurance of academic programs,
- Student-Centered Education (ECTS for learning outcomes),
- Learning VS Teaching (priority of students' individual work and active learning technologies.

To focus on "international standards" in the time of modernization of engineering education in Russia the TEMPUS Project «Engineering Curricula Design aligned with EQF and EUR-ACE Standards» is being fulfilled by TPU (coordinator), MSTU, SPSPU, ENAEE, SEFI and a group of European universities.

In 2011 to work out the new national model of engineering Baccalaureate_TPU initiated the project "Modernization of Bachelor's Programs in Engineering in Accordance with International Standards of Engineering Education".

The project is financed by SKOLKOVO Foundation with the participation of leading Russian National Research Universities of Technology: TPU (coordinator), MEPhI, S.P. Korolev SSAU, MISIS, MIPT, ITMO and Higher School of Economics.

The main tasks of the project are as follows:

- Critical analysis of the engineering education "international standards" (WA, EUR-ACE) and requirements for competences of professional engineers (APEC Engineer Register, EMF, FEANI),

• Analysis and international expertise of the national professional standards, requirements of the FSES and national employers to the Bachelor's programs in SKOLKOVO priority areas of engineering and technology,
• Development of the list of competences for the graduates of engineering Bachelor's programs and their international expertise,
• Upgrading the concept for structure and content of Bachelor's engineering programs with international accreditation and certification criteria in view.

National System of Competences and Qualifications

(Mr O.V. Grinko, Chair of the Group "National System of Competences and Qualifications", the Agency for Strategic Initiatives, Chair of the Board of Directors "SberInvest")

About the Agency

Autonomous non-profit organization "Agency of Strategic Initiatives on the Promotion of New Projects" was founded in compliance with the order № ВП-П16-3168 (item 15) of 17 May 2011 and № ВП-П13-3511 of 27 May 2011 issued by the RF Chairman of the Government V.V. Putin.

According to the RF Government Order № 1393-p of 11 August 2011 the Agency was founded, the Agency Charter was approved and members of its Supervisory Board were assigned with V.V. Putin being the Chairman of the Supervisory Board. In compliance with the Charter the Government of the Russian federation is considered the founder of the Agency.

The Supervisory Board (collegial supreme authorities), Board of Directors (collegial executive authorities) and General Director (single executive body) are approved as the governing bodies of the Agency.

About Young Professionals

The task pursued by the initiative "Young Professionals" includes searching, training and maintaining young professionals in key areas of Russian economy. Rapidly growing business shall have the opportunity to find corresponding specialists within the short period of time, and young people shall have the chance to be trained in specialties being in demand on the market, as well as develop their competencies throughout their lives. The initiative "Young Professionals" is ready to support strong projects aimed at search and development of specialists, focus on key areas of economy, fast acquisition of competencies meeting the world standards, efficient methods of training and exchange of experience using technologies of the future, and creation of the environment for young professionals. Such projects shall take into account potential development of Russian and global education, which is a key factor that cannot be ignored.

The initiative was established in order to solve urgent tasks of professional and staff development of the economy, growth of key areas of the Russian economy, state structures, as well as institutions of education and development.

About National Entrepreneurial Initiative

National Entrepreneurial Initiative on the improvement of the investment climate in the Russian Federation includes 22 projects proposed by entrepreneurs aimed at simplification, cost-efficiency and advancement of existing Russian procedures of conducting the business. The initiative is implemented by the Agency of Strategic Initiatives in compliance with the order of the RF Chairman V.V. Putin issued based on the results of the Congress held by Russian Public Organization "Business Russia" dated 21 December 2011.

About National System of Competencies and Qualifications (NSCC)

In compliance with the meeting minutes of the Supervisory Board of autonomous non-profit organization "Agency of Strategic Initiatives on the Promotion of New Projects" (№1 of 03 May 2012), the roadmap "Creation of the national system of competencies and qualifications" was included into the plan schedule dealing with development of project roadmaps within national entrepreneurial initiative on the improvement of the investment climate in the Russian Federation.

In the framework of such minutes the Agency of Strategic Initiatives (A.S. Nikitin) together with the RF Union of Industrialists and Entrepreneurs, Russian public organization "Business Russia", Russian public association of small and medium entrepreneurship "Russia's Support" and the RF Chamber of Commerce and Industry were assigned to create a working group consisting of representatives of entrepreneurial community together with experts and responsible persons from interested federal executive authorities to develop the roadmap "Creation of the national system of competencies and qualifications".

In June 2012 in the framework of NEI the working group will be developed to deal with the implementation of NSCC which will include representatives of the RF CCI, RUIE, Business Russia, Russia's Support and FEA. In November 2012 the roadmap will be presented to the RF President for approval to implementation.

NSCC is an alternative to the existing model proposed by the Ministry of Education and Science and the Ministry of Health which consider the solution to problems through implementation of standards in education and professional activity.

NSCC Mission is to describe the system based on key characteristics presented by the state, business and an individual with minimum regulatory function of the state (ideal – all have equal rights).

NSCC is a communicative environment where pilot projects are discussed (case studies to develop skills and abilities, certification, qualification and professional standards). NSCC is a way to support projects in the framework of the Agency of Strategic Initiatives (ASI) under two conditions: projects have to be connected with the production and should be aimed to produce competitive products.

NSCC is a communicative environment consisting of three key interrelated objects: State, Business and an Individual providing the release of competitive products and mutual agreement. None of the subjects (civil servant, businessman, citizen) should be discriminated.

NSCC is a competitive and changing economic structure. It provides competition and sustainability, as well as ensures the most favorable conditions in the economy. As far as certification and standardization concerns there is a threat of preservation of the status quo, as competence is needed for the business to solve problems, and only after that the qualification issue can be discussed.

In the framework of NSCC initiative we keep our focus on 2030 (Foresight Competence 2030 supported by the ASI) protocols of the subjects interaction are defined, including intellectual property matters and project approach.

Our vision of the State's role is to establish a platform for "communities of practice" where the State does not actively participate, but provides maximum support to people and ideas, simplifies verification procedure for graduates, limits on-place certifications and qualifications (focus on the best international experience). It is important to create such system (NSCC), where individual is assessed, company provides training, companies creates products together with higher education institutions, and where products are sold. NSCC is a platform with equal opportunities.

Today our economy has lost its connection with companies. Communication is an essential part regarding NSCC initiative implementation. Our perception is that our customer is business; we should stay man-focused and concentrate on a working man. The main issue of the ASI is to capitalize on its value in the market due to its ongoing evaluation. While we have underestimated economy's human capital, this place would not be attractive to professionals.

Glossary

AAE	The Associate ASEAN Engineers
AAET	The Associate ASEAN Engineering Technologists
AAT	The Associate ASEAN Technicians
AB	The Accreditation Board
ABET	The Accreditation Board for Engineering and Technology
AC	The Accreditation Center
ACBET	The Accreditation and Certification Board for Engineering and Technology
ACPE	The ASEAN Chartered Professional Engineer
ACPER	The ASEAN Chartered Professional Engineers Register
AER	The APEC Engineer Register
AET	The ASEAN Engineering Technologists
AFEO	The ASEAN Federation of Engineering Organisations
APEC	The Asia-Pacific Economic Cooperation

APEC P.E.Jp	The APEC Professional Engineer, Japan
ASI	The Agency of Strategic Initiatives
AT	The ASEAN Technicians
BSL	The Building Standard Law
CASEE	The Certification and Accreditation System for Engineering Education
CHED	The Commission on Higher Education
CMO	The Memorandum Order
CPD	Continuing Professional Development
DAB	The Dispute Adjudication Board
EMF	The Engineer Mobility Forum
ENAEE	The European network on accreditation in the field of engineering education
EPCM	The Engineering Procurement and Construction Management

ERDT	The Engineering Research and Development for Technology
EQF	The European Qualifications Framework
EurIng	The European engineer
FEANI	The European Federation of National Engineering Associations (for the abbreviation of its original name the FEDERATION EUROPEENNE d'ASSOCIATIONS NATIONALES d'INGENIEURS)
FEIAP	The Federation of Engineering Institutions of Asia and the Pacific
FEISEAP	The Federation of Engineering Institutes of Asia and the Pacific
FIDIC	The International Federation of Consulting Engineers
GATS	The General Agreement on Trade in Services
HEI	Higher Educational Institution
HRD	Human Resources Division
JAEIC	The Japan Architectural Education and Information Center

JCEA	Japan Consulting Engineer Association IPEJ
JFABEA	The Japan Federation of Architects and Building Engineers Association
JFES	Japan Federation of Engineering Society
JSEE	Japanese Society for Engineering Education
IEA	The International Engineering Alliance
IEET	The Institute of Engineering Education, Taiwan
ITMO	The National Research University of Information Technologies, Mechanics and Optics
Int.P.E.Jp	The EMF International Professional Engineer
IPENZ	The Institution of Professional Engineers New Zealand
MEPhI	The Moscow Engineering Physics Institute
MEXT	The Ministry of Education, Culture, Sports, Science and Technology
MIPT	The Moscow Institute of Physics and Technology
MISIS	The National University of Science and

	Technology
MLIT	The Ministry of Land, Infrastructure, Transport and Tourism
MRA	The ASEAN Mutual Recognition Arrangement
MSTU	Moscow State Technical University
NCEES	The National Council of Examiners for Engineering and Surveying
NSCC	National System of Competencies and Qualifications
NIAD-UE	The National Institution for Academic Degree and University Evaluation
OBE	Outcomes-based Education
PE	The Professional Engineer
PEO	The Professional Engineering Organizations
PRA	The Professional Regulatory Authorisation
PRB	The Professional Regulatory Board
PRC	The Professional Regulation Commission
R&D	Research and Development

RAEE	The Association of Engineering Education of Russia
RF	The Russian Federation
RFPE	The Registered Foreign Professional Engineers
RUSEA	The Russian Union of Scientific and Engineering Associations
SEFI	The European Society for Engineering Education
TC	Technology/Technical Committee
TESDA	The Technical Education and Skills Development Authority
TPET	The Technical Panel for Engineering Technical
TPU	Tomsk Polytechnic University
TWG-OBE	Technical Working Group on Outcomes-based Education
UN	The United Nations
UNESCO	The United Nations Educational, Scientific and Cultural Organization

UPADI	The Pan American Federation of Engineering Societies
WA	The Washington Accord
WFEO	The World Federation of Engineering Organizations
WTO	The World Trade Organisation