A History of the International Engineering Alliance and its Constituent Agreements:

Toward Global Engineering Education and Professional Competence Standards

Those who cannot remember the past are condemned to repeat it.
George Santayana (1863–1952)
The Life of Reason, Volume 1, 1905

Acknowledgements
The contributions and comments of the following are gratefully acknowledged.

Finbar Callanan and Douglas Clyde provided information and insight on the early days of the Washington Accord. Jack Levy, the initiator of the Washington Accord, read an earlier draft of this history. Barry Grear provided information on the early period of the APEC Engineer Agreement. Special thanks go to John Webster for contributing the account of the APEC Engineer Agreement as well as section 4.1. Alec Hay made substantial contributions to the account of the EMF. Terry Stidworthy contributed to the sections on the Sydney and Dublin Accords as well as the ETMF. General contributions of Andrew Cleland, Basil Wakelin, Robin King and See Sew Gue are acknowledged. The Washington Accord history was expanded from that in a booklet published in 2014 to celebrate the 25th anniversary of the Accord written by Robin King and Hu Hanrahan. Hu Hanrahan contributed the Introduction, section 6 on the Graduate Attributes and Professional Competencies, Section 7 on the International Engineering Alliance and section 8 on the realignment of the mobility agreements as well as overall co-ordination.

Version 1: September 2015

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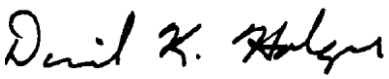
Foreword

For a number of years the Governing Group of the International Engineering Alliance has discussed the need for a documented history to ensure that information about the formation of the Alliance, as well as the constituent Accords and Agreements, and their development are not lost. Hu Hanrahan has been the driving force behind and primary author of this recently completed history. I would find it difficult to consider a more appropriate person to fulfil this role than Hu, and he has succeeded admirably. The Governing Group is grateful to him for the tenacity he has shown in its completion and the detail he has been able to provide in its content.

Hu has been a stalwart supporter of the Alliance, Accords, and Agreements since his first involvement. I have been fortunate to have observed his efforts and to have known Hu for much of this time. The purpose of this history is to educate existing signatories, to preserve information about the formative years of the Accords and Agreements, and to encourage further signatories to consider involvement. As the current Chair of the Governing Group I fully endorse the view of the Group that their wishes have been answered at last by this definitive history. I commend Hu on his attention to detail and the passion with which he has written.

Having read this history nobody will be in any doubt regarding the need for substantial equivalence of engineering education programmes or the success of the Alliance in providing international mobility for engineers. The Governing Group at last has a definitive documented history. I have very much enjoyed reading and learning from this history, and I hope that will be the case for you as well.



David K Holger
Chair of the IEA Governing Group

Accreditation and Registering Bodies Associated with the IEA (June 2015)

The convention in this history is to refer to member bodies of the IEA by their present names except when listing the initial parties to each agreement. The table lists the current names and abbreviations and former names and abbreviations, if applicable.

Abbreviation	Current Name and former name or abbreviation, if applicable[1]
EA	Engineers Australia
	Formerly: Institution of Engineers Australia (IEAust)
BAETE	Board of Accreditation for Engineering and Technical Education [Bangaladesh]
BPERB	Bangladesh Professional Engineers, Registration Board
EC	Engineers Canada
	Formerly: Canadian Council for Professional Engineers (CCPE)
CCTT	Canadian Council of Technicians and Technologists
CAST	China Association for Science and Technology
IEET	Institute of Engineering Education Taiwan
CIE	Chinese Institute of Engineers
CFIA	Colegio Federado de Ingenieros y de Arquitectos de Costa Rica
HKIE	Hong Kong Institution of Engineers
NBA	National Board of Accreditation [India]
IEI	Institution of Engineers India
PII	Institution of Engineers (Indonesia)
EI	Engineers Ireland
	Formerly: Institution of Engineers, Ireland (IEI)
JABEE	Japan Accreditation Board for Engineering Education
IPEJ	Institution of Professional Engineers Japan (IPEJ)
	Formerly: Japanese Consulting Engineers Association (JCEA)
ABEEK	Accreditation Board for Engineering Education of Korea
KPEA	Korean Professional Engineers Association
BEM	Board of Engineers Malaysia
IEM	Institution of Engineers Malaysia
IPENZ	Institution of Professional Engineers New Zealand
PEC	Pakistan Engineering Council
ICACIT	The Institute of Quality and Accreditation of Programmes in Computing, Engineering and Technology Education [Peru]
PTC	Philippines Technological Council
AEER	Association for Engineering Education of Russia
	Formerly: Russian Association for Engineering Education (RAEE)
IES	Institution of Engineers, Singapore
ECSA	Engineering Council of South Africa
IESL	Institution of Engineers Sri Lanka
COE	Council of Engineers, Thailand
MUDEK	Association for Evaluation and Accreditation of Engineering Programs (Turkey)
EngC	Engineering Council [United Kingdom]
	Formerly abbreviated: EC UK
ABET	ABET Inc [USA]
	Formerly: Accreditation Board for Education and Technology (ABET)
NCEES	National Council of Examiners for Engineering and Surveying [USA]
USCEIP	The United States Council for International Engineering Practice[2]

[1] Listed in alphabetical order of country or territory

[2] USCEIP, consisting of ABET, NCEES and the National Society of Professional Engineers (NSPE) was the former representative of the USA on the EMF and APEC Engineer Agreement.

A Note on Terminology

This history uses terms in the way that they are defined in the IEA Educational Accords and competence agreements.

The different types of agreements are referred to as follows:

Accord is used to refer to an agreement for mutual recognition of accredited educational programmes;

Competence agreement refers to an agreement for benchmarking and facilitating mobility at the professional level. (Prior to 2012: *mobility agreement*.)

Accords and Competence Agreements are the *constituents* of the IEA

Accords and Competence Agreements have two levels of membership which for the Accords are:

Provisional status body: a body that has met specified requirements and aspires to signatory status in the Accord;

Signatory: a body having the full benefits and obligations of the Accord.

In the case of competence agreements the two levels of membership are:

Provisional member: a body that has met specified requirements and aspires to authorised membership in the competence agreement;

Authorised member: a body having the full benefits and obligations of the competence agreement. (Prior to 2012 this was *Full Member.)*

Accord Signatories and provisional status bodies as well as Competence Agreement authorised members and provisional members are the *members* of the IEA

The *occupations* or professional roles making up the engineering team are referred to as follows:

Professional engineer: a person with the competence substantially equivalent to that defined for professional engineers who may be registered or licenced with title Professional Engineer, Chartered Engineer, Chartered Professional Engineer, Engineer or equivalent;

Engineering technologist: a person with the competence substantially equivalent to that defined for professional engineering technologist who may be registered or licenced with title [Professional] Engineering Technologist, Associate Engineer, Incorporated Engineer or equivalent;

Engineering technician: a person with the competence substantially equivalent to that defined for engineering technicians.

The IEA Agreements rely on the concept of substantial equivalence of academic programmes or professional formation schemes, which the competence agreements Constitution define as:

Substantial equivalence: The overall outcomes achieved whilst not identical, are repeatable and effectively to the same standard, even if the means by which the outcomes are achieved or assessed are not similar.

For example, when applied to education this means in practice that graduates from substantially equivalent programmes A and B are able to proceed to further professional development toward achieving substantially equivalent professional competency levels.

Abstract

The International Engineering Alliance (IEA) seeks to improve engineering education and competence globally. It fulfils this mission through its constituents: education agreements that are concerned with standards, best practice accreditation processes and mutual recognition of accredited engineering programmes and agreements for defining and recognising professional competence.

The oldest constituent of the IEA, the Washington Accord dating from 1989, is concerned with mutual recognition among its signatories of accredited educational programmes designed to provide the educational foundations for professional engineers. Similarly, the Sydney Accord (2001) and Dublin Accord (2002) are concerned with programmes providing the education foundation for engineering technologists and engineering technicians respectively.

Three IEA constituents are concerned with competence standards for and mutual recognition of experienced engineering professionals. The International Professional Engineers Agreement (IPEA) first came into existence as the Engineers Mobility Forum in 1997. Also concerned with professional engineers is the APEC Engineer Agreement, similar to and with overlapping membership to the IPEA but linked to the Asia Pacific Economic Cooperation. The International Engineering Technologist Agreement (IETA), starting as the Engineering Technologists Mobility Forum in 2001, is concerned with standards for and mobility of engineering technologists.

This work traces the historical development starting with the founding of the Washington Accord flowing into the establishment of the subsequent agreements listed above. We trace the original context and motivation of each agreement, the underlying model, how each evolved, important developments beyond the initial focus on mutual recognition and the present contribution in the modern engineering world. We capture the thinking, goals, methods and achievements of the constituents and the IEA.

The operation of the educational Accords has evolved from broad judgements of substantial equivalence in the original Washington Accord to a formalised approach with Graduate Attribute exemplar standards, defined procedures implemented in robust reviews for admission as a signatory and to maintain signatory status.

A second thrust of the work is the development of the IEA itself. Prior to 2007, each agreement was serviced by a member acting in a voluntary capacity for a period of up to four years. In 2007, the six the six agreements decided to fund a common secretariat which soon became known collectively with the six agreements as the IEA. The IEA, as grouping of authoritative agreements concerned with educational standards and professional competence for engineering professionals, came to be regarded by the wider engineering community as an authoritative body on engineering education and professional standards. In 2014 the IEA adopted a new governance document to give effect to this role.

Repositioning the mobility agreements took place via their 2012 constitutions. The motivation for shifting the prime objective from facilitating mobility to benchmarking professional competency standards is examined.

1. 1989: A watershed year

This history recounts the founding and development of a family of agreements for recognition of engineering education and benchmarking of professional standards in engineering. It spans some twenty five years since the foundation of the Washington Accord in 1989. That event occurred in the context of engineering education, professional formation, practice and professional organisation of engineering which was itself the product of a long evolution. A useful starting point is to note that the engineering of the Industrial Revolution had been essentially practical. During the Industrial Revolution a division of labour took place between engineers, who, while still essentially practical were responsible for the conception and design of machinery and those skilled in their construction – who we today call technicians. While scientific discoveries continued engineering remained practical into the early twentieth century before science-based-engineering became established[1]. As the science base of engineering developed a further division occurred in the second half of the twentieth century, the emergence of the engineering technologist, skilled at applying established technology as distinct from the science-based professional engineer. Thus, in the period covered by this history the roles of professional engineer, engineering technologist and engineering technician exist in many jurisdictions.

The first engineering institutions, voluntary bodies devoted to the promotion of knowledge in the discipline and developing their members, date from the early nineteenth century. Examples are the Institution of Civil Engineers (ICE) (1818), Engineers Ireland (1835) and the American Society of Civil Engineers (ASCE) (1852) or their antecedents. By the early twentieth century engineering institutions existed in many countries, serving single or multiple disciplines. Many of these institutions promoted ethical and professional conduct among their members. Regulation of the professions through registration or licencing is essentially a twentieth century phenomenon – a few bodies were established early in the century with many countries having systems in place by the 1980s. For example, all states in the USA had licencing boards in place by 1950[2]. The development of engineering programme accreditation shows the same slow start but proliferation by the late twentieth century. Early accreditation systems were founded in the USA[3] (1932), Canada (1965) and the UK from 1977[4]; thereafter the development of accreditation systems spread to many countries. Of the many engineering accreditation bodies around the world today, some twenty five are associated with the agreements described below.

In the six countries that were to found the Washington Accord in 1989 there were well established voluntary professional bodies, accreditation agencies and varying degrees and forms of professional engineering regulation. In some countries a single body carried out accreditation and regulation functions while in others multiple bodies existed. The six nevertheless found sufficient common ground in their standards and accreditation processes to contemplate a mutual recognition agreement. In other jurisdictions there were corresponding bodies or the potential for their foundation existed.

A two-stage model for professional engineering formation was well-developed in the original six and subsequently admitted signatory jurisdictions. For example, the development of a professional engineer to the level required for independent practice has an education stage, normally provided by an externally accredited program of 4 or 5 years duration post-secondary school, followed by a period of supervised training while gaining experience in engineering practice. The individual may then

have his or her competence assessed, and be eligible for recognition as a competent engineering practitioner and qualify for registration or licencing. This model underlies the agreements and standards described in this history.

The educational Accords and competence agreements described below play an increasingly important role in the modern globalised economy. While globalisation is a longstanding process, the year of the founding of the Washington Accord, 1989, represents an important watershed in global economic and professional activity. That year is commonly taken to be the end of the Cold War. Subsequently, the political and economic order changed in many countries and economies formerly shut off were opened to the world; open economies became more open. The modest beginnings of the Washington Accord were unwittingly well timed. The Washington Accord has grown and has also acted as the root from which other education and competence agreements have grown to number seven by 2015:

Washington Accord (2001): recognition of education qualifications for professional engineers;
Sydney Accord (2001): recognition of education qualifications for engineering technologists;
Dublin Accord (2002): recognition of education qualifications for engineering technicians;
Engineers Mobility Forum (1997): now the *International Professional Engineers Agreement*;
APEC Engineer Agreement (2000); and
Engineering Technologist Mobility Forum (2003): now the *International Engineering Technologist Agreement*.

In 2015, an agreement was signed to establish the *Agreement for International Engineering Technicians*. Figure 1 summarises the agreements and their relationships.

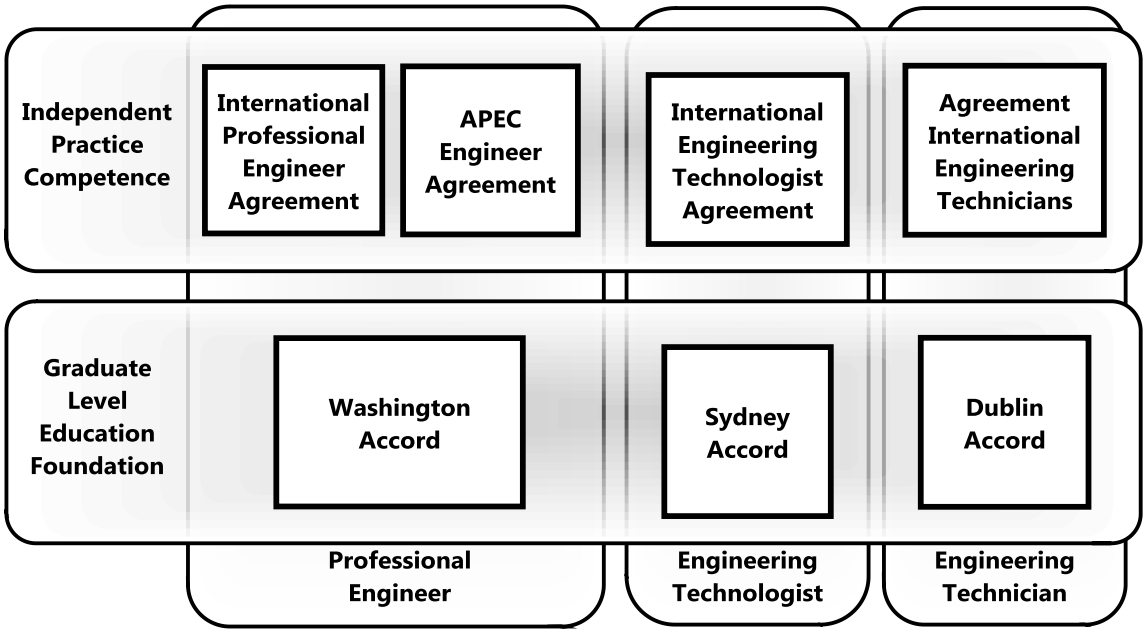


Figure 1: Locating the IEA Agreements by engineering occupation and level

These agreements have in turn spawned the International Engineering Alliance, a body committed to servicing the accords and agreements and promoting global standards for education and professional competence.

The title of this history attempts to convey the existence of separate agreements for recognising engineering education and professional competence and their coming together as the International Engineering Alliance. This account is structured by first considering the individual agreements before describing the later emergence and evolution of the International Engineering Alliance. Section 2 recounts the history of the Washington Accord, the first and largest agreement. Section 3 describes the development of the Sydney and Dublin Accords with the Washington Accord as a base. Section 4 describes mobility agreements for professional engineers. It starts with the genesis of two agreements for recognising the competence of professional engineers and goes on to describe the Engineers Mobility Forum and the APEC Engineer Agreement. Collaboration between the EMF and APEC is recorded here. Section 5 recounts the development of the Engineering Technologist Mobility Forum. A notable achievement of the educational accords and competence agreements, the development of their exemplar standards, the *Graduate Attributes and Professional Competencies*, is recounted in Section 6. Section 7 describes the formation of the International Engineering Alliance to provide a common Secretariat for the Accords and Agreements and its evolution into an authoritative body on educational and professional standards. The competency agreements were repositioned in 2012, as described in Section 8.

2. The Washington Accord

What is the Washington Accord?

The Washington Accord is an agreement between accreditation agencies in different jurisdictions that seeks to provide mutual recognition of education programmes that provide the academic preparation for professional engineers. The Accord exists through the agreement of its signatories and is therefore autonomous and self-governing. The signatories to the Accord are national organisations that accredit engineering higher educational programs that provide graduates with the educational foundation for entry to professional engineering practice, registration or licencing.

Mutual recognition is based on the substantial equivalence of the signatories' programme outcomes, known as graduate attributes, and accreditation processes, verified for each signatory by peer review at the time of admission as a signatory and periodically thereafter.

Signatories agree, if it is within their power, to grant graduates of each others' accredited programs the same recognition, rights and privileges as they grant to graduates of their own accredited programs for the purpose of registration or licencing. Where the registering or licencing body is separate from the accrediting body the signatory undertakes to recommend to the relevant national registration body that accredited programs be recognised. By these provisions, the Accord facilitates mobility of graduates between signatory jurisdictions.

Origins of the Washington Accord Agreement

Prior to 1989 some of the engineering bodies that were to become signatories to the Washington Accord acknowledged the need to mutually recognise graduates through bilateral agreements. For example, the Engineering Council for Professional Development (ECPD), the precursor to ABET, and the Canadian Engineering Accreditation Board (CEAB) of the Canadian Council for Professional Engineers (CCPE) – later to be known as Engineers Canada – signed a mutual recognition agreement in 1979[5].

As a result of meetings initiated and organised by Jack Levy of the Engineering Council UK and David Reyes-Guerra of the USA's ABET, the agreement[6] to become known as the Washington Accord was developed in 1988 and 1989 and signed by the six founding signatories:

The Institution of Engineers, Australia;

The Canadian Engineering Accreditation Board of the Canadian Council for Professional Engineers;

Institution Engineers Ireland;

The Institution of Professional Engineers, New Zealand;

The Engineering Council (United Kingdom with certain Chartered Engineering Institutions); and

The Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (United States).

The founding signatories, convinced that their standards and processes were comparable, agreed to recognise each other's accredited programmes. The objective was to ease the path of graduates to professional registration or licencing in different jurisdictions.

The 1998/9 Washington Accord agreement was motivated by the participants' observation that their respective accreditation processes, policies and criteria were seen to be substantially equivalent[7]. Consequently, graduates of another signatory's accredited programme should be granted the same rights and privileges as graduates of the signatory's own accredited programme in relation to registration or licencing. This particular privilege was identified in the original agreement.

Already, it was recognised that this form of recognition was not in the gift of the accrediting agency if separate registering or licencing body or bodies existed, as was the case in two of the original signatories. The agreement thus imposed, in such cases, an obligation for the accrediting body to recommend to the registering or licencing body (or bodies) to recognise incoming graduates on an equal footing to local graduates if the programmes completed were accredited by signatories. The original agreement made mutual recognition subject to an, as then, unspecified verification process.

The signatories committed to continue to share relevant information; to allow their representatives to participate in each others' accreditation processes; to attend relevant meetings of their organisations and to make reference to the agreement in publications of listings of accredited programs.

Early references, up to about 1993, call the agreement the Six Nation Accord. By the 1995 Meeting of Signatories, the name Washington Accord was entrenched, advisably, in view of the imminent expansion of membership. Washington DC was the site of the initial 1988 meeting, with the agreement finalised in Prague a year later. The original agreement[8] was simply headed "*Recognition of Equivalency of Courses/Programs Leading to the Accredited Engineering Degree"* and this name was carried over to the 1997 revised agreement with minor change. From 2007, the agreement was headed *Washington Accord: Recognition of Equivalence of Educational Base for Engineers at the Professional Level.*

Developments in the 1990s

The Agreement was ratified by the six signatory bodies by April 1990 and came into effect. The first meeting of signatories took place in June 1993 at Montebello, Canada. The WA then embarked on biennial general meetings in odd-numbered years. This continued until 2005 when annual meetings became a practical necessity because of the volume of business; the biennial meeting requirement was retained as a minimum frequency of meetings.

At the 1993 meeting the Hong-Kong Institution of Engineers (HKIE) and the Engineering Council of South Africa (ECSA) expressed interest is becoming signatories and were admitted subject to verification of their accreditation criteria and processes. Verification was completed for the HKIE in 1995 and for ECSA in 1999.

The 1989 agreement was a compact document; it did not, for example, define how new signatories would be admitted. With the admission of new signatories and the growth of interest in the Accord, the need for more structure and formality was recognised at the 1995 Accord meeting in Dublin. Work commenced on a fuller agreement and supporting rules and processes.

The meeting of signatories in Washington DC in 1997 finalised and adopted the more comprehensive Agreement[9] supported by Rules and Procedures[10], which together form the Accord. The basis for mutual recognition, namely the substantial equivalence of signatories' processes, policies and criteria, was fleshed out. The obligations of signatories to accommodate cases where the registering/licencing bodies are different to the accrediting agency was restated to require the accrediting agency to "…make every reasonable effort to ensure [the registering/licencing] bodies accept the substantial equivalence of … programmes accredited by signatories".

New provisions in the 1997 agreement included:

- Requiring unanimous approval for the admission of new signatories;
- Introducing provisional status for a minimum of two years as a mandatory step toward becoming a signatory;
- Providing for the formulation, adoption and amendment of rules and procedures, which in turn, provided for periodic review of signatories;
- Providing for the management of the Accord between meetings by the Chair and Secretariat, the latter to be provided on a voluntary basis by one of the signatories;
- The original agreement required renewal every six years. This was replaced by conventional protocols for termination of the agreement;
- Provision was made for removal of signatories.

The Rules and Procedures clarified the verification process as a periodic review every six years and gave essential detail of the process. This replaced the 1989 Agreement provision for initial admission as signatory that would be confirmed by an, as then undefined, verification process. The process for admission of a new signatory first to provisional status and then as a signatory was also defined. A transitional provision was included for the one signatory not yet verified in 1997, namely the Engineering Council of South Africa.

Washington Accord as Launchpad for other Agreements

Six of the first eight Washington Accord signatories were also responsible for registration of professional engineers in addition to accreditation. The remaining two had relationships with the registering/licencing bodies in their jurisdictions. It was therefore natural that a proposal to investigate a mechanism for mutual recognition of registered professional engineers arose within the Washington Accord, leading to the formation in 1997 of the Engineers Mobility Forum (EMF), described in Section 4.2.

Similarly, most of the eight Washington Accord signatories had interests in engineering technologist education, and in some cases registration of technologists. As described in Section 3, the Sydney Accord was initiated largely by Washington Accord signatories, also spawning the Dublin Accord in due course. The Engineering Technologists Mobility Forum (ETMF) described in Section 5, in turn, grew out of the Sydney Accord deliberations.

Expansion of the Accord 2000-2014

With the new millennium, significant interest in the Washington Accord emerged from Asia. The Japan Accreditation Board for Engineering Education (JABEE) attained provisional status in 2001 and became a signatory in 2005. The Institution of Engineers Singapore followed, becoming a signatory in 2006. In 2007, two further signatories were admitted: the Accreditation Board for Engineering Education of Korea (ABEEK) and the Institute of Engineering Education Taiwan (IEET). The Board of Engineers Malaysia (BEM) was admitted in 2009.

In the present decade four further signatories were admitted: the Association for Evaluation and Accreditation of Engineering Programs (MUDEK) (Turkey) (2011), the Association for Engineering Education of Russia (AEER) (2012), the National Board of Accreditation (NBA) (India) (2014) and the Institution of Engineers Sri Lanka (IESL) (2014). This brought the number of signatories to seventeen in June 2014.

In June 2015 there were six provisional status bodies. Two were from the Indian sub-continent: the Board of Accreditation for Engineering and Technical Education (BAETE) from Bangaladesh, and the Pakistan Engineering Council (PEC). The China Association for Science and Technology (CAST) and the Philippines Technological Council (PTC), represent further interest in Asia. The first applicant from Latin America, admitted to provisional status in 2013, was the Institute of Quality and Accreditation of Programmes in Computing, Engineering and Technology Education (ICACIT) of Peru and was followed in 2015 by Colegio Federado de Ingenieros y de Arquitectos de Costa Rica (CFIA).

Development and Adoption of Graduate Attributes and Common Rules and Procedures

Several signatories developed outcomes-based standards in the latter 1990s and adopted these for accrediting programmes from 2000 onward. This development led to the process described in Section 6, the development and refinement of a Washington Accord Graduate Attribute exemplar.

By 2005, the sister Sydney and Dublin Accords were operating on a similar model to the Washington Accord. The 1997 Rules and Procedures also required expansion. A common set of expanded Rules as well as Guidelines was approved in 2007 and enhanced in subsequent years.

Attaining signatory status has since the original agreement been based on the substantial equivalence of accreditation criteria and processes. Originally, decisions to admit a signatory required a judgement on the part of reviewers that the agency's accreditation criteria and process is substantially equivalent to that of other signatories. The Accord Rules and Procedures of 2007 Rules clarified the criteria for admission to provisional status and as a signatory, supporting such a judgement[11]. After refinement, the criteria applicable for admission at the provisional and signatory stages in the 2014 version were as follows[12].

- For admission to provisional status, the agency must demonstrate through a documented submission, that it has the key characteristics expected of an engineering accreditation agency and has an accreditation system with at least a specified set of features in place. The application must have the support of two signatories as nominators.
- To advance to signatory status, the agency undergoes an on-site review of its accreditation process. Three key requirements must be met. First, the accreditation system must operate according to indicators of best practice. Second, the standards required of accredited programmes by the agency under review must be substantially equivalent to those of the Accord, as exemplified by the Washington Accord Graduate Attributes. Third, the agency must demonstrate that it makes consistent decisions and is likely to do so into the future.

Leadership and Management

Initially, the WA appointed a Chairman from the meeting host country, which also provided the Secretariat. From 1997, one of the signatories took on the Secretariat for up to four years, with a designated individual carrying out the functions. In 2007, the International Engineering Alliance (IEA), described in section 7, was formed to provide the secretariat to this and other agreements. Provision for management of the Accords by a Committee consisting of a Chair and a Deputy Chair was added to the Accords in 2007. The Chairmen, Deputy-Chairmen from 2007 and Secretariat of the WA over its 25 years are listed in Table 1.

Table 1: Washington Accord Chairmen, Deputy Chairmen and Secretariat

Year(s)	Chairmen	Affiliation	Secretariat
1993	Ron Biggs	Engineers Canada	Engineers Canada: Wendy Ryan-Bacon
1995	Finbar Callanan	Engineers Ireland	
1997	Stanley Proctor	ABET	Engineers Australia: Peter Parr
1999	Eleanor Baum	ABET	
2001	Eleanor Baum	ABET	ABET: George Peterson
2002-7*	Peter Greenwood	Engineers Australia	
2007-11	Win Phillips Hu Hanrahan (Deputy)	ABET ECSA	IEA Secretariat provided by IPENZ
2011-15	Hu Hanrahan Andrew Wo (Deputy)	ECSA IEET	
2015-	Andrew Wo Elizabeth Taylor (Deputy)	IEET Engineers Australia	
* The term of office starts at the end of the Accord meeting held in June of the year shown			

Prospects and Challenges

The Washington Accord celebrated its twenty-fifth year in 2014. The Accord has developed both in membership and authority over its 25 years. In 2014 over 7500 programmes accredited by seventeen

signatories enjoy recognition under the Washington Accord. With five provisional status bodies and ongoing expressions of interest, the Accord promises to expand further.

However this expansion has not been without its difficulties. One example was the differing view of what constitutes an acceptable engineering education qualification for professional engineering when the Germany agency ASIIN sought to become a signatory of the Washington Accord on the basis of the its accredited First Cycle Degree. The two-tier qualification structure in Europe under the Bologna system continues to provide challenges to achieving mutual recognition. This is the subject of ongoing work between the IEA and the European Network for Engineering Accreditation (ENAEE) described in section 7.

As the number of signatories increased, diverse models for registration, licencing and regulation of engineering practice were encountered in different countries. The registering or licencing body in the jurisdiction is not always the national member of an IEA competency agreement, that is, the IPEA or APEC described in sections 4 and 5. The seventeen signatories in 2014 exhibit the following types of relationship with registering or licencing bodies in their jurisdictions:

- Nine signatory bodies are also the professional registration authorities; eight of these are also IPEA or APEC EA members and one jurisdiction has a separate IPEA member body;
- In the remaining eight signatory jurisdictions:
  - One has a separate registering body that is also an IPEA body;
  - Seven have registering or licencing authorities not affiliated to the IPEA or APEC; among these six have IPEA or APEC member bodies that are not national registering or licencing bodies.

The original and 1997 agreements recognised that the accrediting and registering/licencing bodies within a jurisdiction could be separate. The Accord text focuses on the mutual recognition of accredited qualifications as meeting educational requirements for registration or licencing, an objective difficult to achieve when the registering/licencing body is decoupled from the Accord and IPEA/APEC. Aspirant signatories see value in the Accord beyond mutual recognition for registration or licencing. Specifically, the adoption of the Graduate Attributes provides a public exemplar of the accredited programme outcomes. While not formally part of the Accord, accreditation of programmes by a signatory as substantially equivalent to the Graduate Attributes exemplar is, in itself, an important form of recognition at the graduate level.

Despite the diversity of regulatory arrangements across signatory jurisdictions, an important common value-adding element is the involvement of the profession in setting and enforcing standards and in accreditation of programs by various means in each country.

The Washington Accord has significant potential for expansion to meet the need for recognition of various types. In 2014 it has six provisional members working toward becoming signatories. Soon the Accord could cover the majority of the World's population. There is widespread aspirational interest in the Washington Accord as it is seen as setting the standard for the global professional engineer.

Whilst Accord recognition strictly applies only to education programs offered within a signatory's territorial boundaries, the need to accommodate developments in cross-border education has required development of rules for out-of-territory accreditation and recognition. Rules agreed in 2009 also

allow for assistance to emerging economies that may small be too small to operate their own accreditation system. These rules are currently under review.

3. Sydney and Dublin Accords

The Sydney Accord

In 1998 a *Technologist and Technician Working Group* was proposed to investigate the development of a mutual recognition agreement for accredited programmes for engineering technologists and technicians. This proposal emerged from a group of Washington Accord signatories meeting to advance the Engineers Mobility Forum. With the exception of Engineers Canada, the eight Washington Accord participants in the 1990s were also engaged in the accreditation of education programmes for engineering technologists. In the case of Canada, the Canadian Council of Technicians and Technologists (CCTT), the responsible body for accreditation of education programmes for technologists and technicians, joined the discussions. ABET, which also accredits technology and technician programs, did not participate in the process at the time but later became a signatory to both the Sydney and Dublin Accords.

This group first met in Ottawa, Canada in June 1999 and became known as the *Ottawa Intent Working Group* after the initial document signed by the participants. The group met again in Sydney, Australia in November 1999. By the Sydney meeting, a draft Agreement on mutual recognition of accredited technologist education programmes had been prepared–hence the appellation Sydney Accord for the agreement finally signed in 2001[13].

The Sydney Accord Agreement and Rules and Procedures largely followed the structure of the 1997 Washington Accord. The major difference was a lower majority for required admission of new signatories, a measure deemed necessary for the growth of the Accord in its early years. From 2007, the Rules and Procedures and Guidelines were common with the Washington and Dublin Accords.

The Sydney Accord was signed at the June 2001 meeting in Thornybush, South Africa by:

- Institution of Engineers, Australia;
- Canadian Council of Technicians and Technologists;
- Hong Kong Institution of Engineers;
- Institution of Engineers Ireland;
- Institution of Professional Engineers New Zealand;
- Engineering Council of South Africa; and
- Engineering Council, United Kingdom.

ABET was admitted as a signatory in 2009, followed by ABEEK in 2013 and IEET in 2014, taking the Sydney Accord to ten signatories. Nine of the ten are Washington Accord Signatories, representing the subset of IEA members with accreditation of education programmes for professional engineer and engineering technologist – and in most cases, technicians – under one roof.

The Dublin Accord

The Dublin Accord, concerned with engineering technician education, followed similar lines to the Sydney Accord. A principal difference is that, rather than providing for mutual recognition of individual accredited programmes, it recognised typifying qualifications for engineering technician

education. This approach was necessary because technician education in some countries is based on national qualifications or qualifications controlled by a designated authority rather than programmes offered by autonomous providers. In admitting a signatory the decision would be made whether the standards of the national or designated system are substantially equivalent to the Dublin Accord Graduate Attribute exemplar and whether the accreditation processes applied conform to Accord best practice. This approach accommodates both national qualification as well as individually accredited programmes.

The Dublin Accord was signed in Dublin, Ireland on 13 May 2002 by the four founding signatories:

- Canadian Council of Technicians and Technologists;
- Institution of Engineers Ireland;
- Engineering Council of South Africa; and
- Engineering Council, United Kingdom.

Four further signatories were admitted in 2013: Engineers Australia, ABEEK, IPENZ and ABET.

The Sydney and Dublin Accords were participants in the development of Graduate Attributes described in Section 6. This development provided a clear differentiation of the graduate level competencies of professional engineers, engineering technologists and engineering technicians.

Table 2: Sydney Accord Chairmen, Deputy-Chairmen and Secretariat

Period	Chairman	Affiliation	Secretariat
Ottawa Intent Working Group			
1998-2001	Barry Dobson	EngC	CCTT: Charles Brimley
Sydney Accord			
2001-2003	Barry Dobson	EngC	CCTT: Charles Brimley
2003-2005			ECSA: Terry Stidworthy
2005-2007			Engineers Ireland: Denis McGrath
2007-2011	Alex Chan Robin King (Deputy)	HKIE Engineers Australia	IEA Secretariat provided by IPENZ
2011-2015	Robin King David Holger (Deputy)	Engineers Australia ABET	
2015-	David Holger Ohyang Kwon (Deputy)	ABET ABEEK	

Table 3: Dublin Accord Chairmen, Deputy-Chairmen and Secretariat

Period	Chair	Affiliation	Secretariat
2003-2007	Barry Dobson	EngC	Engineers Ireland: Denis McGrath
2007-2011	Denis McGrath George O'Neill (Deputy)	Engineers Ireland EngC	IEA Secretariat provided by IPENZ
2011-2016	George O'Neill Damien Owens (Deputy)	EngC Engineers Ireland	

Leadership and Management of the Sydney and Dublin Accords

As shown in Table 2, the leadership of the Ottawa Intent Working group flowed into the Sydney Accord as soon as it was established. The Dublin Accord, with its common membership in the Sydney Accord was served by many of the same individuals. Tribute must be paid to Barry Dobson for his long service to both Accords. As with the Washington Accord, a signatory and a designated individual

assumed responsibility for the Secretariat prior to 2007 when the IEA was formed and common Rules and procedures adopted.

4. Mobility Agreements for Professional Engineers

4.1 Events Leading to Mobility Agreements at the Professional Level.

Before describing the Engineers Mobility Forum, it is worth noting that the year 1995 saw the start of two, initially independent but later converging, processes that culminated in the development of agreements aimed to ease mobility of professional engineers.

The Washington Accord signatories, meeting in Dublin in June 1995 agreed to explore mechanisms for mutual recognition for experienced professional engineers. Representatives of the engineering profession in each of the Washington Accord signatory jurisdictions, together with observers nominated by the European Federation of National Engineering Associations (FEANI), met in March 1996 in Hong Kong. The group became known as the Hong Kong Working Party (HKWP). It met again, with the addition of observers from the Japan Consulting Engineers Association[14], in January 1997 in San Diego, USA. The Engineers Mobility Forum described in Section 4.2 emerged from the HKWP deliberations.

The Asia Pacific Economic Co-operation (APEC) Leaders' Meeting, held in Osaka in November 1995, decided that urgent action must be taken to facilitate the mobility of qualified persons among the member economies. Based on this action agenda, the meeting of the APEC Human Resource Development (HRD) Ministers, held in Manila in January 1996, and attended by the representatives of 18 economies, decided that the project initiatives on mutual recognition of skill qualifications must be accelerated and expanded, and instructed the APEC HRD Working Group to progress the matter. The Group met later that month in Wellington, New Zealand, and agreed to support an Australian initiative on professional engineering accreditation, recognition and development, with the detailed design of the programme being delegated to a Steering Committee. Subsequent development of the APEC Engineer Agreement is described in section 4.3.

4.2 The Engineers Mobility Forum

Early developments toward the Engineers Mobility Forum[15]

The participants in the initial HKWP meetings exchanged information on, and made a preliminary assessment of, their respective processes, policies and procedures for granting recognition to experienced engineers via registration or licencing. They concluded that these were sufficiently comparable to justify further work. They agreed on the broad principles of a framework which might enable progress towards removing artificial barriers to the free movement and practice of professional engineers amongst their countries. Agreement was reached on the principles and outline process by which the substantial equivalence in competence of experienced engineers could be established. The participants recognised that such arrangements would only be fully effective if the controlling bodies within each country or territory accepted their validity, and streamlined the procedures for admission to practice in their jurisdictions for experienced engineers applying through the framework. They also recognised that the value of the proposed framework would depend upon the extent to which the participants were successful in building confidence in each others' processes within their own constituencies.

Progress made by the HKWP was reported to the biennial meeting of signatories to the Washington Accord held in Washington DC on 27 and 28 October 1997. The signatories welcomed the progress that had been made and encouraged the relevant organisations to establish an independent forum in which the strategies that had been proposed could continue to be developed. To that end, a further meeting of representatives from these organisations was convened the next day where it was agreed to establish a forum to be known as the Engineers Mobility Forum (EMF). Founding organisations were from Australia, Canada, Hong Kong China, Ireland, New Zealand, South Africa, United Kingdom and the United States. Participants endorsed the preparation of the initial version of a Memorandum of Understanding (MoU). The MoU was ratified at a meeting of the Forum in London in July 1998. At that time, the participants endorsed a draft of an Agreement to establish and maintain an EMF International Register of Professional Engineers as a basis for consultation within their respective constituencies.

Following a period of consultation in each of the relevant jurisdictions, at a meeting of the Forum in Sydney, Australia in November 1999, the participants agreed to amend the Memorandum of Understanding. The founding members were all from Washington Accord jurisdictions and the amendments permitted a wider range of organisations to become Members of the Engineers Mobility Forum. This expanded recognition to individuals who did not hold qualifications recognised under the Washington Accord. As a result of this change, the Japan Consulting Engineers Association and the Board of Engineers, Malaysia were admitted as members at the meeting. They further agreed to endorse the revised Memorandum of Understanding as a fair record of the outcomes of the meeting and to seek formal ratification by the organisations which they represented. A revised draft of the *Agreement to Establish and Maintain an International Register of Professional Engineers* was tabled for consideration by the respective countries.

Following a period of further consultation, at a meeting of the Forum in Vancouver Canada in June 2000, the participants endorsed a second revision of the Memorandum of Understanding and a final draft of the Agreement to establish and maintain an EMF International Register of Professional Engineers for ratification by their respective constituencies. The Korean Professional Engineers Association was admitted as a member of the Forum at the meeting. In addition, the Forum approved Draft Rules for the International Register Co-ordinating Committee which would be responsible for the creation and consistent operation of the decentralised International Register.

Following ratification by all participant organisations of the Memorandum of Understanding and the Final Draft Agreement, the EMF members met at Thornybush in South Africa on 25 June 2001. The following members signed the Agreement[16]:

The Institution of Engineers Australia;
Canadian Council of Professional Engineers;
Hong Kong Institution of Engineers
Institution of Engineers Ireland;
Institution of Professional Engineers Japan;
Korean Professional Engineers Association.
Institution of Engineers Malaysia;
The Institution of Professional Engineers New Zealand;
Engineering Council of South Africa;
Engineering Council, United Kingdom;
United States Council for International Engineering Practice (Later succeeded by NCEES).

The members agreed to bring together the Memorandum of Understanding and the Agreement into one document, the EMF Constitution, which, as far as possible, used the same wording as the original documents. The Constitution was approved at the General Meeting of the EMF held at Rotorua New Zealand in June 2003, together with amended Rules for the International Register Coordinating Committee.

The EMF Constitution made provision for Full Members and Provisional Members. A Full Member – which may or may not be responsible for registering professional engineers in its own economy – has authorization to maintain a section of the International Register. A Provisional Member is an organisation developing to meet the requirements for Full Membership. The EMF met in two modes: the Forum with Full Members, who had voting rights, Provisional Members, Observers and visitors; and the International Register Co-ordinating Committee, where only Full and Provisional Members attended.

The founding members were joined by further full members: the Institution of Engineers Singapore (2007), the Institution of Engineers Sri Lanka (2007), the Institution of Engineers India (2009) and the Chinese Institute of Engineers (Chinese Taipei) (2009). The EMF became the International Professional Engineers Agreement in 2013 (see Section 8). Provisional members in 2015 are: the Pakistan Engineering Council, the Association for Engineering Education Russia and the Bangaladesh Professional Engineers Registration Board.

The EMF Agreement

The purpose of the EMF was stated in the Constitution as:

> The members of the Engineers Mobility Forum … aim to facilitate international mobility of 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.

The aim of facilitating mobility was to be achieved via a series of measures[17]. The EMF would develop, monitor, maintain and promote standards and criteria to facilitate mobility of experienced professional engineers. As attaining mobility was – and still is – not without difficulty, the Forum intended to seek an understanding of the existing barriers to mobility, to develop and promote strategies to aid governments and licensing authorities to manage barriers and to adopt and implement mobility procedures consistent with EMF standards. To promote confidence in registration systems for experienced professional engineers the EMF would identify and promote best practice for the preparation and assessment of engineers intending to practice at the professional level and continue mutual monitoring of national systems and information exchange by suitable means. To provide a framework for recognition of the substantial equivalence of the competence of experienced professional engineers from the participating economies the EMF established a decentralised International Register of Professional Engineers.

The Agreement evolved in subsequent years. At the General Meeting of the EMF held at Cyberport, Hong Kong in June 2005, additions to the Constitution covered bilateral agreements, the International Professional Engineer (IntPE) designation, admission as a provisional and full member and the

periodic review process of Full Members' systems. The International Register Coordinating Committee, at its meeting in Hong Kong, approved guidelines for mentoring intending members.

Following the outcomes of a workshop held in Dublin, Ireland in 2006, further amendments and additions were proposed and adopted on granting rights of practice and the use of multilateral and bi-lateral agreements. An important change was made to clarify the Guidelines on Criteria and Procedures for progression from provisional to full member. The required academic achievement at the point of entry the International Register was substantially equivalent to that of the Washington Accord. The guideline on methods of satisfying this criterion was amended to deem this requirement met if a Washington Accord signatory in the jurisdiction had accredited the applicant's qualification. A practical extension of this was that Full Membership of the EMF essentially required an accrediting body of Washington Accord signatory status to exist in the jurisdiction. Provisional members could accept a range of specified programmes but would need to achieve the Washington Accord standard to progress to Full Member.

Also in 2006 it was observed that low numbers of persons had registered on the international registers. The EMF consequently re-ordered its objectives: while maintaining benchmarking as the first priority, this was followed in priority by best practice and monitoring, the international register and addressing barriers to mobility. This was to foreshadow the realignment of the mobility agreements recounted in section 8.

As described in section 7, a common Secretariat for all agreements was established in 2007. At the General Meeting of the EMF held at Washington DC, USA on 21 June 2007, the term 'Executive Committee' was introduced to clearly distinguish the Chair and Deputy Chair of the EMF from the newly appointed Secretariat. The procedure for appointment of the Chair and Deputy Chair was expanded. A new Schedule on Multilateral and Bilateral Agreements was inserted together with an additional clause on Monitoring Committees to operate the decentralised register in each member jurisdiction.

At the General Meeting of the EMF held at Kyoto, Japan, in June 2009, the document "Graduate Attributes and Professional Competencies", although accepted by the EMF from its inception, was formally adopted by creating a new Schedule where the engineer portions of that document were regarded as exemplars of the competence to be demonstrated on attaining registration[18].

International Professional Engineer Register

Each member of the EMF was expected to operate a decentralised part of the International Register of Professional Engineers. The register was intended to provide a framework for the recognition of experienced professional engineers by responsible bodies in each of the Member organisation's economies. In particular, such bodies were encouraged to use the Register as a secure benchmark for arrangements which provide mutual recognition or exemption or at least streamline access by professional engineers to licensing or registration in economies other than that in which they first gained recognition.

Nothing in the arrangements for the International Register was intended to limit the rights of any Member organisation to conclude bilateral or multilateral agreements with any other organisations on

different terms from those implied by the requirements for entry to the International Register of Professional Engineers.

The International Professional Engineer (IntPE) Register was envisaged as a decentralised register operated by EMF members authorised to do so. The standard for the IntPE was set beyond that generally required in the member jurisdictions for professional engineer registration, namely a defined educational standing and demonstration of the competence for independent practice. An international register applicant already registered in the home jurisdiction was expected to also have at least seven years total experience since graduation, have "spent at least two years in responsible charge of significant engineering work" and have maintained his or her continuing professional development.

The education requirement set by the 2008 EMF Constitution required full members of the Forum to require an educational qualification that is substantially equivalent to a Washington Accord degree. There were initially EMF members that were not Washington Accord signatories or did not have a signatory in its jurisdiction; over time such members or accreditation agencies attained Washington Accord signatory status. The EMF agreement did not however accommodate engineers who had met the educational requirements by individual routes.

At the meeting in South Africa in 2001, the Forum approved the Rules for the International Register Co-ordinating Committee. The EMF adopted the practice of each member and intending member preparing and maintaining an Assessment Statement. This summarises the procedures and criteria used in the jurisdiction and would be used in considering applications for authorisation to operate a section of the International Register and for ongoing monitoring. The Assessment Statements of all the members of the Forum were presented and all were approved. Thus, each EMF member became a full member with interim authority to open a decentralised portion of the International Register and the Co-ordinating Committee was formally established.

Development of the EMF

By 2009, the EMF had grown steadily to fifteen full and three provisional members. Ten full members were also members of the APEC Engineer Agreement. However, the take up of the International PE Register by individual engineers varied across the full members. The role of the IntPE Register in facilitating mobility of experienced professional engineers was below expectation despite the bar for entry being higher than that for entry to a home jurisdiction register. Limitations to granting rights of practice manifested in the form of few mutual exemption[19] arrangements being put in place by members and the low demand from individuals seeking registration in another jurisdiction via the IntPE Register. Rather, in cases when a need to support migration existed, members entered bi-lateral agreements with specific procedures. While the EMF Agreement allowed bi- or multi-lateral agreements to become addenda to the main agreement this was not taken up. Such addenda would confirm that the standards and practices of the bi-lateral agreement were consistent with those of the EMF.

The EMF had anticipated the application of *competency-based assessment* as an alternative approach to time-based requirements for the IntPE Register[20]. The EMF was a participant in the development of the Graduate Attributes and Professional Competencies described in Section 6. The EMF Constitution of 2009 indicates that "… the professional competency profile for the professional engineer record[s] the elements of competency necessary for competent performance that the

professional is expected to be able to demonstrate in a holistic way at the stage of admission to the international register". This was in agreement with the Graduate Attributes and Professional competencies 2005 edition[21]. However, in the second revision of the Graduate Attributes in 2009 and again in 2013, there was general acceptance that the professional competency profile defined the common understanding for registration or licencing in the individual jurisdictions. The professional competency profile therefore provides an exemplar for members developing competency-based standards and assessment for their professional engineer registration. The uptake of the professional competency profile was slower to take root than the adoption of the Graduate Attributes by the Washington Accord.

Obstacles to mobility of professional engineers became apparent as early as 2003. The test of a mobility agreement is the attainment of right to practice by a professional engineer registered and experienced in one jurisdiction being granted credit for criteria fulfilled in another. The reality within the EMF was different. Five of the then eleven Full Members were prepared to give credit for criteria to those on the register, two had some restrictions and the other four were constrained by statutory and other considerations and relied on bi-lateral agreements. All Members however agreed that the EMF needed to continue to use the international register as the basis for granting credit for common requirements. By comparison, the educational Accords have served the EMF well: mutual recognition of accredited educational qualifications as meeting commonly agreed standards was undisputed in the EMF. However, the recognition of educational qualification is only part of the mobility criteria, as the full recognition is only achieved when granting right of practice is achieved.

The somewhat disappointing impact of the International Register overshadowed the relative success of the EMF, along with the ETMF and the APEC Engineer Agreement, in setting competency benchmarks. These outcomes led the three mobility agreements to the change process and altered approach described in section 9.

Engineers Mobility Forum Leadership

The Chairmen and Secretariat of the EMF and its predecessor, the Hong Kong Working Party, are listed in Table 4.

Table 4: Engineers Mobility Forum Chairmen, Deputy Chairmen and Secretariats

Period	Chair	Affiliation	Secretariat
Hong Kong Working Party			
1996-1997	John Webster	Engineers Australia	
Engineers Mobility Forum			
1997-1999	John Webster	Engineers Australia	USCEIP: Betsy Brown
1999-2003	Robin Wilson	EngC	ECSA: Alec Hay
2003-2007	Alec Hay	ECSA	EngC: Chris Simpson
2007-2009	Alec Hay Basil Wakelin (Deputy)	ECSA IPENZ	IEA Secretariat provided by IPENZ
2009-2013	Basil Wakelin Nam Ho	IPENZ KPEA	
2013-2014	Basil Wakelin Alex Chan (Deputy)	IPENZ HKIE	
2014-	Alex Chan See Sew Gue (Deputy	HKIE IEM	

4.3 APEC Engineer Agreement

Development of the APEC Engineer Agreement

The Steering Committee referred to in Section 4 met in May 1996 in Sydney, Australia, and commissioned a full survey of professional institutions and societies, procedures and criteria for the registration of professional engineers, and frameworks for engineering education and development. The results of that survey would, it was hoped, provide a basis for identifying current best practices in professional engineering accreditation, recognition and development. Funding was provided by the Australian Government.

The ultimate objective was to facilitate mutual recognition of engineering qualifications and occupations by professional associations and licensing agencies in all APEC economies and, in the process, to build durable collaborative networks. The focus was on identifying best practice in delivering and accrediting engineering courses, and in assessing the capacity of graduates, after supervised training and experience, to undertake independent engineering practice. The final survey results did not become available until mid-1997 but it rapidly became obvious that there were substantial, and often deeply entrenched, variations amongst the higher education systems and the quality assurance frameworks under which they operated.

The Chief Executive of the Japan Consulting Engineers Association (JCEA), Shigeatsu Taki, aware of these issues, and of the successful conclusion of the initial meeting of the Hong Kong Working Party, visited Australia in March 1996. He invited the Chief Executive of the Institution of Engineers Australia (IEAust) to visit Tokyo in October 1996 to discuss accreditation and mutual recognition issues with senior government officials, leading members of the engineering profession, and key university leaders. In the course of these discussions, it became clear to all parties that the APEC project could offer a vehicle through which to pursue mutual recognition at the level of the experienced professional engineer. All member economies of APEC could participate in an APEC project, and there appeared to be a good chance of achieving mutually satisfactory outcomes. That might in turn enable the complex tasks of gaining university support for professional accreditation and thereby establishing the substantial equivalence of educational standards between jurisdictions to be undertaken in an atmosphere of improved mutual confidence and understanding.

Both IEAust and JCEA intended that the APEC project proceed in parallel to, and develop synergies with, the work of the HKWP, membership of which was, at that time, open only to representatives of the members of the Washington Accord. Almost immediately, Australia, Japan, Indonesia and the Philippines committed themselves to support the revised goals for the project, and expressions of interest were received from several other economies. At the same time, the Chief Executive of JCEA was invited to observe the HKWP meeting in San Diego in January 1997. Shortly afterwards, the Japanese Society for Engineering Education was invited to send an observer to the Washington Accord meeting scheduled for October 1997. Together, these invitations marked a key step towards widening the coverage of mutual recognition agreements.

Given the somewhat discouraging outcomes of the opening stage of the APEC Project, and the enthusiastic support offered by several economies for the concept of a mutual recognition agreement operating at the experienced practitioner level, the Steering Committee decided to make pursuit of this more modest goal the next objective of the Project. To that end, a Best Practices Workshop was

organised in Manila during August 1997, and was attended by delegates from Australia, Hong Kong China, Indonesia, Japan, Malaysia, Philippines, Singapore, and Thailand, together with observers from the United States.

This meeting achieved, in retrospect, far more than even the most enthusiastic proponents of the concept had expected. By the end of the second day, the APEC representatives had progressed their thinking to a point that had taken the Washington Accord six years to achieve, and reached agreement on a constitution, rules and procedures which provided opportunities for economies to secure international recognition for a substantial number of their more experienced engineers. The strengths of the system were the same as those of the Washington Accord−decentralised processes validated by mutual review and strengthened by continuous improvement.

The subsequent APEC administrative processes were completed with unusual speed, and an initial meeting of the Steering Committee for the APEC Engineer project was held in Sydney, Australia in November 1998. The meeting was attended by delegates from Australia, Canada, China, Hong Kong China, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, and Thailand, together with observers from the US and Vietnam. (Five of the participants were members of the EMF.) The meeting reached agreement on a wide range of practical issues, including the disciplines to appear on the Registers, and the procedures through which the Coordinating Committee and the Monitoring Committees responsible for individual Registers should carry out their respective tasks.

By the time the Steering Committee met in November 1999, again in Sydney, but this time in concert with the meetings associated with several other international agreements, the United States had revisited its original intention to participate only as an observer, and decided to become a full participant. Many of the economies had already appointed or identified Monitoring Committees, and the system was essentially in place. The Steering Committee stood down at the end of the Sydney meeting, its work complete, and a Coordinating Committee was constituted, with the founding members being Australia, Canada, Hong Kong China, Japan, Korea, Malaysia, and New Zealand. Coordinating Committee meetings in Vancouver in June 2000 and Kuala Lumpur in October 2001 tidied up the remaining loose ends. Indonesia, Philippines and the Unites States were authorised to maintain APEC Engineer registers, and Thailand was given conditional authorisation. Singapore and Chinese Taipei became members in 2005 as did Russia in 2010.

The resulting Agreement[22] framed the objective as: "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". The first edition of the APEC Engineer Manual was issued in 2001.

Reflection

In many ways, the Engineers Mobility Forum and the APEC Engineer Project, each group benefiting from the work of the other, quite apart from being highly successful in their own right, catalysed acceptance of programme-based accreditation in jurisdictions that had no previous history of such interactions between universities and the engineering profession, and thereby facilitated the subsequent rapid expansion in scale and diversity of the membership of the Washington Accord.

Table 5: APEC Engineer Agreement Chairmen and Secretariat

Period	Chairman	Affiliation	Secretariat
1997-1999	Barry Grear	Engineers Australia	
1999-2001	Barry Grear	Engineers Australia	David Lapp (CCPE)
2001-2003	See Sew Gue	IEM	David Lapp (CCPE)
2003-2005			Michael Bevan (IEAust)
2005-2007	Fumio Nishino	IPEJ	Michael Bevan (IEAust)
2007-2009	See Sew Gue Ong See Ho (Deputy)	IEM IES	IEA Secretariat provided by IPENZ
2009-2011	See Sew Gue Za-Chieh Moh (Deputy)	IEM CIE	
2011-2013	Nam Ho Za-Chieh Moh (Deputy)	KPEA CIE	
2013-2015	Za-Chieh Moh Seng-Chuan Tan (Deputy)	CIE IES	
2015-2017	Seng-Chuan Tan Patty Mamola (Deputy)	IES NCEES	

The subsequent growth and convergence of a complete spectrum of international agreements, and the emergence of the International Engineering Alliance, covering all members of the engineering team, with a professional secretariat, and a regular programme of administrative meetings, owes much to the way in which the APEC Engineer Project demonstrated how mutual recognition based on substantial equivalence of outcomes could transcend cultural and political differences.

APEC Engineer Leadership

Table 5 lists the Chairmen and Secretariat of the APEC Engineer Agreement.

4.4 APEC-EMF Collaboration

Following suggestions made at the meetings in South Africa in 2001, a joint workshop for the APEC Engineer Agreement and the EMF was organised for the meetings in New Zealand in 2003. At that time eight of the eleven EMF Full members were also members of the APEC Engineer Agreement.

The workshop participants recognized the following:

- There had been substantial convergence between the criteria for registration as an APEC Engineer and those for registration by the EMF as an International Professional Engineer.
- In many jurisdictions, the Monitoring Committees dealing with applications for admission to both registers have the same membership, and undertake a single assessment process;
- The processes for verification and review applicable to signatories to the APEC Engineer Framework and the EMF are essentially the same, and
- Significant advantages could be gained from encouraging further convergence between the APEC and EMF Registers, without losing the brand value associated with either register, or the benefits associated with the commitment by governments to the APEC Register.

Discussions took place over a number of meetings in the following years. A merger between the two Coordinating Committees was proposed early on but the three non-APEC countries in the EMF, all signatories to the Washington Accord, did not accept this. The enduring difference between the agreements' respective requirements for admission to the registered lay in the education base; other

requirements were identical. The EMF required a degree substantially equivalent to that of the Washington Accord; this was one of the options available to APEC Engineer applicants. Adoption of the Graduate Attributes and Professional Competencies in 2005 further strengthened the alignment of the EMF with the Washington Accord. Other differences mitigating against merger were the regional nature of APEC while the EMF was open to qualifying bodies around the World free to co-operate with other regional bodies such as FEANI.

Both groups recognised that where a body had membership of both agreements, and had approved assessment statements for both agreements, the monitoring process could be done jointly to reduce costs for the member concerned. This meant also that the monitoring team had to come from jurisdictions with membership of both agreements.

5. Engineering Technologist Mobility Forum

Five of the EMF participants were from jurisdictions that recognised and registered or afforded membership to engineering technologists: Engineers Australia, Hong Kong Institution of Engineers, Engineers Ireland, Engineering Council and the Engineering Council of South Africa. In Canada, the Canadian Council of Technologists and Technicians was the responsible body. All were founders of the Sydney Accord as described in Section 3. Arising out of a proposal at the EMF Working Group meeting in 1998, the eventual Sydney Accord signatories explored mutual recognition for experienced engineering technologists during its meetings Sydney in November 1999 and Thornybush, South Africa in June 2001.

The approach was similar to the development of the EMF: exchange of information on engineering technologist registration systems and preliminary assessment of each others' processes, policies and procedures for granting recognition to experienced engineering technologists. The participants concluded that these were sufficiently comparable to justify further work. They agreed on the broad principles of a framework which might enable progress towards removing artificial barriers to the free movement and practice of engineering technologists amongst their countries. An agreement in the form of a Memorandum of Understanding was reached on the principles and outline processes by which the substantial equivalence in competence of experienced engineering technologists could be established.

At their meeting on 25 June 2001 at Thornybush, South Africa, the Sydney Accord signatories established a forum, to be known as the Engineering Technologists Mobility Forum (ETMF). The ETMF would develop, monitor, maintain and promote mutually acceptable standards and criteria for facilitating the cross-border mobility of experienced engineering technologists. In view of the diversity of registration systems they would seek an understanding of the existing barriers to mobility, and develop and promote strategies to manage those barriers and encourage governments and licensing authorities to adopt and implement mutual mobility procedures consistent with the standards and practices established by and through the ETMF.

The ETMF would also identify and encourage the implementation of best practice for the preparation and assessment of engineering technologists intending to practice internationally at the professional level.

The envisaged operation of the ETMF was along the lines already established by the EMF: mutual monitoring and information exchange; invitations to observe the operation of the procedures and proceedings of other participants.

By the meeting of agreements held at Thornybush in South Africa in June 2001, the participants were ready to recommend that the organisations which they represented consider becoming signatories to a draft Agreement to establish and maintain an International Register of Engineering Technologists. The six founding members of the ETMF as a result of this process were:

Canadian Council of Technicians and Technologists;
The Hong Kong Institution of Engineers;
Engineers Ireland;
The Institution of Professional Engineers New Zealand;
The Engineering Council of South Africa;
The Engineering Council, United Kingdom.

The ETMF Agreement[23] was signed in June 2003 at Rotorua, New Zealand. Engineers Australia became a provisional member of the ETMF in 2010. Membership of the ETMF remained at the six founding members and one provisional member, Engineers Australia, by 2015.

The ETMF Agreement included a provision to establish and maintain an International Register of Engineering Technologists. This was intended to provide a framework for the recognition of experienced practising engineering technologists by the responsible bodies in each of the signatory economies. In particular, such bodies were encouraged to use the Register's benchmark to underpin arrangements for mutual recognition or exemption or streamlined access by engineering technologists to licensing, registration or certification in economies other than that in which they first gained recognition. The agreement was not intended to inhibit members from concluding bilateral or multilateral agreements on different terms from the ETMF International Register of Engineering Technologists.

Uptake of the ETMF International Register was also limited. The ETMF also took part in the re-alignment of the competency agreements recounted in section 8.

Table 6: Engineering Technologists Chairmen and Secretariat

Period	Chair	Affiliation	Secretariat
2001-2003	Terry Stidworthy (ECSA)	ECSA	Charles Brimley (CCTT)
2003-2007			Chris Simpson (EngC)
2007-2009	David Long Yaro Zajac (Deputy)	EngC	IEA Secretariat provided by IPENZ
2009-2011	David Long§ Yaro Zajac (Deputy)	EngC	
2011-2013	Faried Allie¤ Graham Woodrow (Deputy)	ECSA EngC	
2013-	Graham Woodrow (EngC) Jones Moloisane (Deputy)	EngC ECSA	
§ Resigned 2010: Remainder of term Chaired by Deputy ¤ Passed away 2012: Remainder of term Chaired by Deputy			

Engineering Technologists Mobility Forum Leadership

During the development of the ETMF, the Chairman was by Barry Dobson as indicated in Table 2 for the Ottawa Intent. Leadership from the founding of the ETMF in 2001 is shown in Table 6.

6. Development of Graduate Attributes and Professional Competencies

The mid-1990s: Rethinking the Purpose of Engineering Education

When the Washington Accord was signed in 1989, the signatories' criteria for accredited programmes focussed on the inputs to and the process of education. Emphasis fell on curriculum structure, content and the technical depth achieved. Miksad attributed the primacy of technical depth to the assumption that "… graduates must be immediately productive in their first job" [24]. In the mid-1990s in several Washington Accord Signatories were questioning their traditional accreditation criteria which were often long lists of inputs to programmes. A typical question posed at the time was, for example, also from Miksad: "Do we educate engineers to be staff technocrats superbly trained for their first job, or do we educate engineers for a lifetime of earning and learning?" In response to questions such as this a new consensus on requirements statements for engineering competency and education emerged. New thinking was exemplified by Rugarcia et al in a 2000 paper[25]. They linked the characteristics of modern society to the attributes that engineers must have to function effectively. Society is characterised by proliferating information, multidisciplinary technologies, globalized markets, an endangered environment, growing social responsibility, participatory work modes and rapid change – conditions which are still relevant today. To function effectively in this environment, engineers must have profiles with three components, knowledge, skills and attitudes captured by Rugarcia and colleagues:

> "(1) their *knowledge*—the facts they know and concepts they understand; (2) the *skills* they use in managing and applying their knowledge, such as computation, experimentation, analysis, synthesis/design, evaluation, communication, leadership, and teamwork; (3) the *attitudes* that dictate the goals toward which their skills and knowledge will be directed—personal values, concerns, preferences and biases".

The result of this thinking was the simultaneous development of standards for engineering programmes based on programme outcomes in a number of jurisdictions including Australia[26], Ireland, New Zealand, South Africa and the United States. Program outcomes were selected to match industry's expectations of entry-level graduate with industry input and validated[27]. The new standards were phased-in from 2000 onwards. At the same time the approach to accreditation of programmes changed. With the adoption of programme outcome standards, freedom to design programmes to meet those standards could be given to education providers. Former input specifications on programme design and pedagogy became inappropriate and were removed. The accreditation criteria in many jurisdictions were essentially reduced to four key questions: Is the programme design coherent and consistent with the programme objectives? Are the programme outcomes appropriate and are they being assessed? Is the teaching and learning of adequate quality? Is the programme adequately resourced and sustainable? The accreditation evaluation process changed from auditing a large number of detailed criteria to a broader judgement against these questions. Apart from the programme outcomes, little else was prescribed in the typical accreditation standards. For example, rather than prescribing inputs to achieve sustainability, accreditation processes evaluated the evidence of sustainability of the programme as presented to them by the provider.

Developing the Graduate Attributes and Professional Competency Profiles

Against this background, the Washington Accord, meeting at Thornybush in 2001, accepted a proposal that a study be undertaken to establish whether a consensus existed on the outcome standard for accredited programmes. At that time aspirant signatories were evaluated by a judgement of the substantial equivalence of the applicant's accreditation criteria to that of other signatories. A consensus on the standard could potentially reduce the subjectivity of this judgement. The Accord had not yet commenced periodic reviews of signatories as required by the 1997 Rules and Procedures, giving an unconstrained opportunity to work on standards. A small working group built on standards that were already available, including the ABET EC2000 criteria and other work in progress.

The Sydney Accord had just been signed at this time. While not part of the initial working group, its signatories had a natural interest in a consensus standard for technologist education. A similar interest manifested once the Dublin Accord was signed in 2002. Both these Accords participated in the development of outcome-oriented standards from 2003 onward.

The Engineers Mobility Forum, already established at this stage, defined criteria for admission to the international register based on the applicant's education, professional registration, and time-based additional experience and advanced level responsibility. The education requirement would be satisfied by a Washington Accord degree or its equivalent. Competency assessment based on outcome standards was not yet the practice. The EMF Constitution however envisaged that signatories could, over time, develop an alternative route to the International Register via competency assessment, using work-derived evidence assessed against standards. Signatories of the EMF therefore decided to prepare consensus outcomes-based statements of professional competency. Initially it was thought that the standards might be at the International Register level but the actually standard arrived at was for the entry to independent practice, that is for registration as a professional engineer. Analogously, the Sydney Accord graduate attributes apply in future competence-based assessment systems for independent practice as an engineering technologist under the ETMF.

When the Accord signatories and mobility agreement members met again in June 2003 at Rotorua, a contribution from the hosts, IPENZ, gave the initiative a significant boost. IPENZ had developed outcomes-based standards both at the educational and registration levels covering professional engineers, engineering technologists and engineering technicians. These showed that, at the educational level, the outcomes for each engineering role could be based on the same elements, for example problem analysis, design, communication and teamwork, graded according to the expected performance in each role. A method of grading the demands in terms of problem solving and engineering activity was presented. A similar approach was used to define the competency required at the registration level for the engineer, engineering technologist and engineering technician roles. The three educational accords and the EMF and ETMF agreed to meet in June 2004 to pursue the development of a consensus statement of educational and professional competence outcomes.

The first workshop of the Accords and mobility agreements was held in London in June 2004 with the formulation of consensus outcomes at the educational and professional levels as the primary objective. Building on the approach of IPENZ and individual standards that had been developed by a number of signatories, the participants developed the first draft of the *Graduate Attributes and Professional Competencies*[28].

Graduate attributes, defined for each engineering role, are individually assessable programme outcomes for the role, supported by definitions of the expected level of problem solving and engineering knowledge for that role. Graduate attributes were defined for the engineer, engineering technologist and engineering technician roles consistent with the purpose of the qualification, namely providing the educational foundation for development toward professional competence.

The *professional competency profiles* for each professional category record the elements of competency necessary for competent performance that the professional is expected to be able to demonstrate in a holistic way at the stage of attaining registration. While no mobility forum for engineering technicians existed, several participants had formulated competencies for engineering technicians. It was therefore natural for the 2004 workshop to create graduate attributes and professional competency profiles for the whole engineering team.

The *Graduate Attributes and Professional Competencies* were approved by the educational Accords and EMF and ETMF in June 2005 at their Hong Kong meetings. The graduate attributes were not intended to be a prescriptive standard. Rather, they were accepted as "… exemplars of the attributes expected of graduate from an accredited programme". As exemplars they could nevertheless be used as a reference for judging the standards of an accrediting agency on a substantial equivalence basis. The Graduate Attributes and professional competencies reflect a first step toward a global consensus on educational outcomes and professional competencies[29]

Implementing the Graduate Attributes as an Exemplar Standard

Signatories reported in 2007 on their experience with the Graduate Attributes. Several signatories recounted using the GA as a reference when formulating their own outcomes-based standards. Some reported that the GA have proved useful in understanding and explaining the differences in expectations between programmes for different engineering roles, for example in engineering and engineering technology.

The *Graduate Attributes and Professional Competencies* underwent revision in 2009 and 2013. A knowledge profile, differentiated for engineers, engineering technologists and engineering technicians was added in Version 2 of 2009. Version 3 of 2013 contains a clarified statement of the level of problem solving and raises the profile of sustainability of engineering solutions. Version 3 added the APEC Engineer Agreement to its list of constituents. The APEC Engineer Agreement accepts programmes that conform to the guidelines of the Federation of Engineering Institutions of Asia and the Pacific (FEIAP) as meeting its educational requirement. The FEIAP guidelines in turn refer to the Washington Accord Graduate Attributes[30].

Applicants wishing to progress from provisional to signatory status in an educational Accord have since June 2007 been required to demonstrate that their outcome standard for accredited programmes is substantially equivalent to the Accord Graduate Attribute exemplar. In 2012 and 2013, all signatories performed and reported on a gap analysis of their standard against the relevant Accord exemplar. The 2014 Accord Rules and Procedures require the team reviewing a signatory to report on their evaluation of the substantial equivalence of the signatory's accreditation standard to the Accord Graduate Attribute exemplar.

7. The International Engineering Alliance

Supporting the Educational Accords and Mobility Agreements

In 2015, the number of bodies that accredit engineering programmes or register professionals either on national or international registers associated with the IEA reached thirty two, spread across twenty five jurisdictions. The current jurisdictions having members and provisional members of the various agreements are listed in Appendix B and are shown graphically in Figures 1 and 2. Of the 24 jurisdictions shown in Figures 2 and 3 and listed in Appendix B, nine have five or six memberships, involving one or two organisations in the jurisdiction.

Over the period 1997 to 2003 the number of education and mobility agreements grew from one to six. At that time each agreement elected a Chairman and was supported by one of its member organisations, and invariably a dedicated individual, in a voluntary secretariat role. Tables 1 to 6 record the member organisations and individuals who acted as Chairman and Secretary for the six agreements from their founding date to 2007.

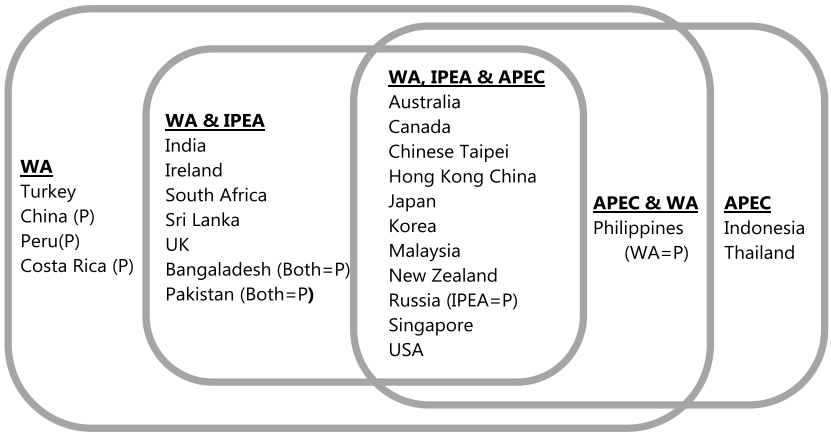


Figure 2: Summary of jurisdictions with membership of agreements related to professional engineer education and competence (P = provisional status)

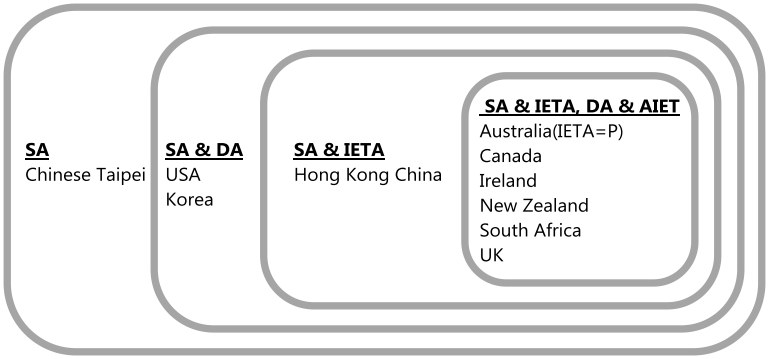


Figure 3: Summary of jurisdictions with membership of agreements related to engineering technologist and engineering technician education and competence

Over the period 1997-2001, meetings to develop other agreements were held on the occasion of the Washington Accord meetings and at other times. Multi-agreement meetings would soon become a reality. In 2001, a number of meetings of established and developing agreements took place at a single location, Thornybush, South Africa. By 2003, six agreements were established and the first meetings

for all agreements were planned for Hong Kong. Due to the SARS epidemic, the meeting was shifted at short notice to Rotorua, New Zealand.

By 2003 experience gained in education and mobility meetings demonstrated the need for workshops or forums where delegates of all agreements could take part in discussion of matters of common interest or concern. The Rotorua meetings in 2003 saw the start of such discussion forums. The need was identified to develop concepts and documents via workshops for subsequent presentation to accord and agreement general meetings. Coordination of meetings of the Accords and Agreements into a pattern of workshops in even numbered years and general meetings in odd numbered years was adopted.

At the 2003 meetings the need for a common secretariat to support all six agreements was recognised. Having such a secretariat was vital as volunteers could no longer carry the workload, especially as the various agreements envisaged a major program of periodic review of each signatory or member to ensure they are keeping to the benchmark standards. The first tangible step toward common support for the agreements was the creation of a common website by IPENZ, the first www.ieagreements.org.

The agreements considered a proposal for a common secretariat in 2005. This was then developed into a Multi-party Agreement (MPA) presented to and signed by the three education Accords and three mobility agreements in June 2007. The MPA provided for a Secretariat to service all six agreements. Secretariat was to be funded by fees paid by the signatories and members according to their memberships and size of their operations, measured by the number of accredited programmes or registrants on the international register.

The Multi-party Agreement also established a Governing Group consisting of the Chairmen of the six agreements to supervise the operation of the agreement. Later, the Governing Group was expanded to include the Deputy Chairmen as well. The Governing Group leadership is listed in Table 7

Table 7: Governing Group Leadership

Period	Chairman	Affiliation	Secretariat
2007-2010	David Long Denis McGrath (Deputy)	EngC Engineers Ireland	IEA Secretariat provided by IPENZ
2010-2011	Win Phillips Denis McGrath (Deputy)	ABET Engineers Ireland	
2011-2015	Basil Wakelin David Holger (Deputy)	IPENZ ABET	
2015-	David Holger Alex Chan	ABET HKIE	

The MPA defined the process for appointing a body to provide the Secretariat. After a bidding and adjudication process defined in the MPA, IPENZ was appointed to provide the permanent secretariat. The name International Engineering Alliance (IEA) was coined by the Governing Group in 2007 for the group of agreements served by the Secretariat.

The IEA Secretariat in Operation

With the establishment of the IEA Secretariat and identity, the individual education Accords and mobility agreements continued to function autonomously but were now served administratively by the Secretariat; it was no longer necessary to appoint a volunteer secretary in each agreement. The educational Accords adopted common Rules and Procedures including guidelines for their operation in 2007. These provided for a Chairman and Deputy Chairman in each Accord. The mobility agreements made similar provisions. In terms of the new Rules the Chairman and Deputy of each agreement formed an Executive Committee to carry out delegated functions between meetings, supported by the Secretariat.

With the IEA Secretariat in place and growth of the agreements supporting what had now become annual meetings and a full programme of reviews of signatories and international register operators, the membership of agreements grew.

As indicated above, the IEA name was coined as a convenient collective noun for the educational accords and competency agreements which, because of their common roots and membership, continued to work closely. The establishment of common standards in the form of the Graduate Attributes and Professional Competencies and the evaluation of members' accreditation and registration systems was seen a setting benchmarks both internally in the IEA and in the external engineering world. The IEA, while set up originally to serve its constituent agreements, was seen by the outside world as an authoritative body on standards for education and professional registration.

A New Vision and Role for the IEA and the Agreements

In 2009 the World Federation of Engineering Organisations (WFEO) formulated its policy on accreditation of courses (programmes) and mobility of professionals[31]. WFEO recognised the emergence of a framework of global standards with the Washington Accord and the EMF as key players. WFEO expressed its belief in defining competence using generic attributes for graduate and practicing engineers; this was consistent with the approach of the IEA *Graduate Attributes and Professional Competencies*. WFEO adopted the approach of endorsing the standards of other bodies rather than setting its own standards for engineering education and professional competence.

This relationship was further cemented in April 2014 when WFEO and the IEA signed a Memorandum of Understanding[32]. The objective of the MoU was "to raise awareness of the importance of accreditation of engineering qualifications and competence assessment to global standards." The need was recognised to build political and financial commitment for and capacity of national accreditation and competence assessment bodies. It was envisaged that such bodies would progress to a point where they could be mentored by IEA members to further build their capacity to a point where they can join the IEA accords and agreements as provisional and eventually full members.

In view of the IEA and its constituent agreements becoming *de facto* an authority on educational and professional competency standards, a new IEA Governance and Procedures[33] document was adopted in 2014. This document subsumed the MPA, thus continuing the Secretariat function, but introduced a new vision for the IEA, namely:

The International Engineering Alliance seeks to improve engineering education and competence globally through widening the recognition and uptake of its constituent Accords and Agreements.

Co-operation with European Accreditation and Professional Bodies

The IEA constituent agreement members and provisional members are located in North America (2), Australasia (2), Asia (14), Africa (1) Europe (4) and Latin America (2). The IEA educational Accords and competency agreements cover three engineering occupations: professional engineer, engineering technologist and engineering technician. While the IEA standards are seen by an increasing number of countries as an aspirational goal in many parts of the globe, the IEA recognised that this does not extend readily to much of Europe. Europe-specific institutions and practices, for example the Bologna three-cycle qualification structure exhibit differences that render comparisons and mutual recognition complex. Similarly, the form of registration or licencing found among IEA members is the exception in Europe. The IEA therefore maintains an on-going relationship with the European Federation of National Engineering Associations (FEANI) and the European Network for Engineering Education (ENAEE). Four countries hosting IEA member bodies are also involved in FEANI and ENAEE, namely Ireland, Russia, Turkey and the United Kingdom. ENAEE authorises accreditation agencies to award the EUR-ACE Label to programmes meeting the programme outcomes at bachelors and masters level. At the time of writing there are thirteen authorised agencies[34]. FEANI operates the European Engineer (EUR ING) Register allowing engineers with acceptable combinations of education and experience from the diverse professional systems across Europe access to a common professional title.

The Washington and Sydney Accords have engaged with ENAEE to explore future modes of co-operation. This required understanding of each others' standards and processes as well as the recognition afforded graduates of Accord accredited and EUR-ACE labelled programmes.

The first product of this collaboration was the publication in 2015 of a joint compilation on best practice in accreditation[35] based on the practices defined in the Accord Rules and Procedures and the EUR-ACE Framework Standards and Guidelines[36], as well as other authorities on programme accreditation.

8. Repositioning the Mobility Agreements

Rethinking the Mobility Agreements 2009-2012

As indicated in Sections 4 and 5, the primary objective of the mobility agreements, namely, to enhance mobility of experienced professional engineers and engineering technologists through the International Register mechanism, proved elusive.

Dixon, in a 2013 study of mobility of the engineering workforce[37], recognises the increasing scale of cross-border engineering activity but identifies significant barriers to mobility related to regulatory practices. Arrangements for recognition of a professional already recognised in one jurisdiction in another are complex. Obstacles to such re-certification include varying degrees of regulation, differing scope of engineering tasks and differential recognition of engineering education. The organisation of engineering occupations often differs between jurisdictions. Agreements between professional bodies are often not binding on other bodies that recognise professionals. A conclusion of

this study relevant to the mobility agreements is that mutual recognition arrangements "… may well have more value as an internationally recognisable benchmark rather than as a ticket to immediate recognition by regulatory authorities".

The EMF, ETMF and APEC Engineer agreements therefore re-examined their objectives and approach over the period 2009 to 2012. This exercise also gave the opportunity to rationalise the three agreements' documents and adopt the practices applied in the unified educational Accord Rules and Procedures from 2007. New constitutions[38] for the three competence agreements were adopted in June 2012 for implementation from 1 January 2013.

The original objective of the mobility agreements was to facilitate international mobility of experienced professional engineers and engineering technologists respectively. Mobility would be achieved through a framework for their recognition based on confidence in the integrity of the national assessment systems of each member's section of the International Register. Confidence would be built through continuing mutual inspection and evaluation of those systems. In the review, the system of assessment for professional registration in the jurisdiction would also be examined; this system would either be operated by the agreement member or another body.

The pre-2013 EMF and ETMF Constitutions anticipated a future outcomes-basis for the definition and assessment of professional competency. This was not a requirement: criteria for admission to the EMF international register were stated in terms of the applicant's educational achievement substantially equivalent to the Washington Accord; having been assessed for independent practice–usually corresponding to registration in the home jurisdiction; time-based minimum requirements: seven year experience in total including two years in responsible charge of significant engineering work; and being current with continuing professional development.

Progress to an outcomes-based standard for professional competence was slow. In the 2009 version of the EMF Constitution reference was made to IEA *Graduate Attributes and Professional Competencies* (GA&PC) as an exemplar without prescribing it. This removed doubt created by the professional competency profile being identified in the 2005 GA&PC as defining the competency for the international register. From the second version of the GA&PC in 2009, the professional competency profiles defined the competency for independent practice, corresponding to registration, recognising that the International Register standard is more demanding. The 2012 Constitutions confirm that the professional engineering competence for independent practice is exemplified by the IEA competency profile.

New Identities for the Competence Agreement

The 2012 Constitutions for the three agreements significantly changed the objectives, identities and modus operandi of the agreements, as described below. Arising out of the change of primary emphasis from mobility to benchmarking, the 2012 Constitutions establish the International Professional Engineers Agreement (IPEA), and the International Engineering Technologist Agreement (IETA), and brings the APEC Engineer Agreement (APECEA) into a common framework described as *competence agreements* rather than the earlier mobility agreements. These are multi-lateral agreements between groups of jurisdictional agencies either responsible for the oversight or operation of national registration or licensure schemes or international registers. These agencies have chosen to

work collectively to establish a common understanding of what constitutes competence in engineering at three levels: professional engineer, engineering technologist and engineering technician.

The three agreements formally commenced in January 2013, superseding earlier agreements (IE 2012):

The *International Professional Engineers Agreement* (IPEA) supersedes the Engineers Mobility Forum. The IPEA provides for recognition of substantial equivalency of standards and quality assurance systems used to establish the competency of professional engineers for independent practice

The *APEC Engineer Competence Agreement* (APECEA) supersedes the APEC Engineer agreement. The APECEA provides for recognition of substantial equivalency of standards and quality assurance systems used to establish competency of professional engineers for independent practice within the APEC economies.

The *International Engineering Technologist Agreement* (IETA) supersedes the Engineering Technologists Mobility Forum. The IETA provides for recognition of substantial equivalency of standards and quality assurance systems used to establish competency of engineering technologists for independent practice

In 2015 six Dublin Accord signatories committed to a competency agreement for engineering technicians. The agreement, to be known as the *Agreement for International Engineering Technicians* (AIET) was modelled on the three existing agreements after repositioning. The technician graduate attributes and professional competency profile already defined serve as exemplars for the AIET. The inaugural leadership of the AIET is recorded in Table 8.

Table 8: Leadership of the Agreement for International Engineering Technicians (AIET)

Period	Chairman	Affiliation	Secretariat
2015-	Keith Jacobs Louis LeBel (Deputy)	ECSA CCTT	IEA Secretariat provided by IPENZ

Members of competency agreements are committed to development and recognition of good practice in assessing competence for independent practice in engineering. The collective activities of the members are intended to assist growing globalisation of shared understanding of competence for independent practice in engineering at different competence levels.

A New Role for the Competence Agreements

The 2012 Constitution for each agreement sets as its primary objective to establish an "… international benchmark competence standard for individuals undertaking independent practice in [the respective engineering role] … ." Each Constitution's purpose statement also requires "a framework for the recognition of substantial equivalence of standards and quality assurance systems to be established and maintained through continuing periodic review of each member's standards and systems". Standards and quality assurance referred to are those for assessment of individuals against the benchmark competency standards. Assurance of substantial equivalence may then enhance mutual exemption between jurisdictions via streamlined procedures for the recognition of competent

individuals crossing jurisdictions. The Constitution also provides for continuing the international registers but using the competency benchmark as the entry requirement.

The 2012 Constitutions provide for two types of membership: provisional and authorised members. The obligations of authorised members are as follows. Consistent with the Agreements' objective to set a benchmark standard of competence, each authorised members must establish a benchmark competence standard that has essential components. This is the standard for the International Register. Standards of academic achievement are defined. A standard of competence for independent professional practice is required. Specific aspects of competence are listed: ethical responsibility, accountability and continuing professional development – which are in fact components of the IEA competency profile and are in general integral to the jurisdictions' professional competence standards. In addition, minimum periods of total experience since graduation and in responsible charge of engineering work are retained from the Pre-2012 Agreements as well as the requirement to maintain continuing professional development at an acceptable level.

The education requirement within the benchmark standard relies on the IEA Graduate Attributes. Authorised members of the IPEA are expected to require programmes recognised under the Washington Accord; provisional members may use alternative educational benchmarks. This effectively means that the organization accrediting engineering degrees in an IPEA authorised member's jurisdiction must hold signatory status of the Washington Accord. The APECEA 2013 constitution accepts a wider range of methods of demonstrating educational achievement: a FEIAP-accredited degree, or a WA-accredited degree or various structured examinations. The IETA, while linked to the Sydney Accord, allows a range of methods for international register applicants to satisfy the educational requirement: a Sydney Accord degree, or examination, or outcomes-based assessment. Similarly, the newly formed AIET uses substantial equivalence with the Dublin Accord typifying qualification as its educational benchmark.

The IPEA and APECEA rely on the IEA professional engineer competency profile while the IETA uses the IEA engineering technologist competency profile (IEA 2013) for defining the competence for independent practice component of the benchmark.

Each Authorised Member must operate a section of the International Register in the form of voluntary registration of persons already on a jurisdictional register or registers who are assessed by the authorised member as meeting the benchmark competence standard and have agreed to be bound by a code of ethics acceptable to the Agreement. The authorised member may impose additional requirements, for example to comply with local legislation or regulation and to be able to communicate professionally in language(s) used locally. Persons so registered may use the title appropriate to the register, for example International Professional Engineer (IntPE), APEC Engineer or International Engineering Technologist (IntET). Each local register forms a section of the relevant International register.

The Agreements are not primarily intended to provide mutual recognition but aim to ensure that, in the case of an incoming applicant via the International Register, assessment performed in the originating jurisdiction is not duplicated the receiving Authorised Member's jurisdiction. Authorised Members undertake to limit the assessment of applicants who are registered in their original

jurisdictions and on the local section of the international register to establishing that, in the context of its jurisdiction, the applicant is able to practice proficiently, are currently competent and can communicate effectively.

Authorised Members are obliged, within reason, to promote the International Register standard as a benchmark standard of competence for independent practice in professional engineering in their jurisdictions–a task that will be difficult because of the more demanding requirements for the international register compared with the national register in most cases.

In view of the different driving forces between organisations which seek to become members of the competency agreements and those for individuals who might seek to become internationally recognised and also to reduce the evaluation burden on individuals and institutions, the constituents agreed in 2015 to continue to work on the possibility of recognising national competence registers as meeting the IEA international requirements. This work is ongoing.

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Appendix A: A Timeline for the IEA and its Constituent Agreements

Year	Milestone
1988	• Washington DC. Initial version of agreement signed by four of six original signatories
1989	• Prague, Czechoslovakia. Revised agreement signed. Washington Accord comes into existence; founding signatories are: ABET, CCPE, EC UK, IEI, IEAust, IPENZ
1993 June	• General Meeting of Washington Accord: Montebello, Canada • HKIE and ECSA admitted to WA subject to verification of accreditation systems
1995 June	• General Meeting of WA: Dublin, Ireland. • Hong Kong Institution of Engineers verified as signatory • Working Group to explore potential for developing mobility agreements appointed
1996 March	• Mobility Working Group meets in Hong Kong at HKIE's Offices-called Hong Kong Working Party – 8 WA signatories present except the EC(UK) (not able to attend) and FEANI as observer.
1997 January	• HK Working Group meets in San Diego, USA for second meeting. FEANI and Japan Consulting Engineers Association present as observers.
1997 October	• General Meeting of WA: Washington DC • Revised Accord developed and signed: Provisional Status introduced • First Accord Rules and Procedures published • Engineers Mobility Forum (EMF) founded: Founding Members: IEAust, CCPE, HKIE, IEI, IPENZ, ECSA, EC UK, USCEIP
1998 July	• EMF meets in London at ICE's Offices-Initial MOU ratified and draft Agreement produced • Working Group proposed for technologist's education.
1999 June	• Meeting of above Working Group in Ottawa results in proposed Ottawa Intent to establish a recognition agreement for technologist education
1999 November	• General Meeting of WA, EMF and Ottawa Intent Working Group- Sydney, Australia • Engineering Council of South Africa verified as signatory of Washington Accord • Ottawa Intent signed on 8th Nov 1999 by CCTT, IEAust, IPENZ, HKIE, ECSA, IEI and EC UK • Ottawa Intent Working Group produce first drafts for Sydney Accord and the MOU for the ETMF • IPEJ and IEM (initially was the BEM) become Full Members of the EMF • EMF produces revised MOU and revised draft Agreement • APEC Engineer Co-ordinating Committee meets for first time. Founding Economies: Australia, Canada, Hong Kong China, Japan, Korea, Malaysia, New Zealand
2000 June	• APEC Engineer Co-ordinating Committee meets in Vancouver, Canada • EMF meets in Vancouver, Canada • MOU and draft Agreement further revised • KPEA becomes Full Member of the EMF
2000 Nov	• APEC Engineer Register commenced (where/what occasion?).
2001 June	• General Meeting of WA, EMF and Ottawa Intent Working Group held at Thornybush, South Africa. • Development of consensus statement of expected Washington Accord outcomes commenced, later (2004) to become the Graduate Attributes for all Accords. • Admission of JABEE to provisional status in Washington Accord • Inaugural meeting of the EMF International Register Co-ordinating Committee held and all signatories are given interim authorisation to open a decentralised sections of the register. • EMF Agreement was signed at Thornybush in South Africa on 25 June 2001: Founding Members: IEAust, CCPE, HKIE, IEI, IPENZ, ECSA, EC UK, USCIEP, JCEA, IEM, KPEA • Sydney Accord Signed on 25 June 2001: founding signatories: EC UK, IEI, CCTT, ECSA, HKIE, IEAust, IPENZ

	• Ottawa Intent Working Group establish the Engineering Technologists Mobility Forum: ETMF MoU signed on 25 June 2001
2001	• Indonesia, Philippines and USA become member economies of APEC Engineer
2002 May	• Dublin Accord signed in Dublin, Ireland on 13 May 2002 by founding signatories: EC UK, IEI, CCTT, ECSA
2003 June	• International Engineering Meetings scheduled for Hong Kong moved to Rotorua, New Zealand due to SARS outbreak. General meetings of all agreements. • IEIndia and BPERB (Bangladesh) admitted as Provisional Members of EMF • EMF Constitution approved and adopted • APEC holds meeting within multi-agreement programme at Rotorua • IES (Singapore), BEM (Malaysia) and ASIIN (Germany) admitted to provisional status in WA • Thailand becomes member of APEC Engineer • ETMF Agreement signed on 13 June 2003 in Rotorua by: HKIE, IEI, IPENZ. ECSA, CCTT and EC UK • Post nominals proposed for mobility agreements • IPENZ creates www.ieagreements.org to replace previous standalone websites for the agreements • Proposal paper for a common secretariat presented by IPENZ
2004 June	• First multi-agreement Workshop, London, UK • Development of first version of the Graduate Attributes and Professional Competencies • Matrix of Benefits and IntPE Protocol for EMF • First periodic Review of a Washington Accord Signatory
2005 June	• International Engineering Meetings held in Cyberport, Hong Kong. • Graduate Attributes and Professional Competencies approved • Admission of JABEE as signatory to the Washington Accord • ABEEK and IEET (Taiwan) admitted to provisional status in WA • IES and IESL (Sri Lanka) admitted as Provisional Members of EMF • ETMF Constitution approved • CIE (Taiwan) and IES become member economies of APEC Engineer • Development of multi-party agreement, principles of the underpinning contributions system, schedule of services for secretariat • Agreement to develop a single set of Rules and procedures covering all three Accords • IntPE and IntET postnominals approved
2006 June	• IEM Workshop and Interim meetings held in Dublin, Ireland • Developing education Accord Rules and Procedures, final developments for provision of a Joint Secretariat, Developing Countries • Admission of IES as WA signatory • IPENZ admitted to provisional status in the Dublin Accord
2007 June	• International Engineering Meetings held in Washington DC, USA • Signing of Multiparty Agreement by WA, SA, DA, EMF, ETMF and APEC for the formation of Governing Group and appointment of IPENZ as Joint Secretariat • Changes to all agreements to remove voluntary secretariat and introduce a Deputy Chair and Executive Committee • Admission of ABEEK and IEET as WA signatories • Adoption of Accord Rules and Procedures covering Washington, Sydney and Dublin Accords • AICTE India, IESL and RAAE (Russia, later AEER) admitted to provisional status in the WA • ABET admitted to provisional status in the Sydney and Dublin Accords • IES and IESL become Full Members of the EMF • ETMF approved all assessment statements authorising full members to open decentralised sections of the technologists register
2007	• Meeting of Governing Group, London, UK

August	• Adoption by GG of name of International Engineering Alliance
2008 January	• Meeting of Governing Group, Johannesburg, SA
2008 June	• IEA Workshop and Interim Meetings: Singapore • IPENZ and IES accepted for Procedure B for WA and SA monitoring • CIE (Taiwan) admitted as Provisional Member of EMF
2009 June	• IEA Meetings: Kyoto, Japan • All agree to title International Engineering Alliance • BEM admitted as signatory to WA • Graduate Attributes and Professional Competencies Version 2 Approved • ABET admitted as Signatory to Sydney Accord • CIE and IE India become Full Members of the EMF
2010 June	• IEA Workshop and Mid-term meetings held in Ottawa, Canada (Terminology of Mid-term meetings adopted) • Discussions commenced to change the nature of Mobility Agreements to a standards setting and monitoring body. • MUDEK (Turkey) and PEC (Philippines) admitted to provisional status in the WA • ABEEK admitted to provisional status in the Sydney and Dublin Accords • Engineers Australia admitted as a Provisional Member of the ETMF
2011 June	• IEA Meetings: Taipei, Taiwan • Admission of MUDEK as signatory to WA • BAETE (Bangladesh) admitted to provisional status in WA • Engineers Australia admitted to provisional status in the Dublin Accord • PEC admitted as Provisional Member in EMF • Commencement of development of new Rules and Procedures and Constitutions for three mobility agreements
2012 June	• IEA Workshop and Mid-term meetings, Sydney, Australia • Admission of AEER (was RAAE) as signatory to Washington Accord • IPEA succeeds the EMF and IETA succeeds the ETMF. New Constitution and Rules adopted for competence agreements • Graduate Attributes Gap as exemplar for substantial equivalence of signatory standards • Graduate Attributes Gap Analysis undertaken • IEET admitted to provisional status in the Sydney Accord
2013 June	• IEA Meetings: Seoul, Korea • Graduate Attributes and Professional Competencies Version 3 Approved • New constitutions for the Mobility Agreements approved, including comprehensive Rules and Procedures • Revised governance structure for IEA developed for approval in 2014 • ABEEK, Engineers Australia, IPENZ and ABET admitted as signatories to Dublin Accord • ABEEK admitted as signatory to Sydney Accord • CAST (China) and PTC (Philippines) admitted to provisional status in WA • Provisional Status of ASIIN in WA terminated • AEER admitted as Provisional Member in IPEA
2014	• IEA Workshop and Mid-term Meetings: Wellington New Zealand • Washington Accord 25th Anniversary Celebration • IEA Adopts new Governance document to define expanded purpose: The IEA seeks to improve engineering education and competence globally through widening the recognition and uptake of its constituent Accords and Agreements. • NBA India admitted as signatory to the Washington Accord • IESL admitted as signatory to the Washington Accord • ICACIT Peru admitted to provisional status in the Washington Accord • IEET admitted as a signatory to the Sydney Accord.

Appendix B: Summary of Accord Signatories and Agreement Members at 25 June 2015

S = Signatory or Authorised Member **P** = Provisional Status Body/Member **F** = Foundation Member (AIET Only)								
Jurisdiction	**Body**	**WA**	**SA**	**DA**	**IPEA**	**IETA**	**APEC**	**AIET**
Australia	Engineers Australia	**S**	**S**	**S**	**S**	**P**	**S**	**F**
Bangaladesh	Board of Accreditation for Engineering and Technical Education (BAETE)	**P**						
	Bangladesh Professional Engineers, Registration Board (BPERB)				**P**			
Canada	Engineers Canada	**S**			**S**		**S**	
	Canadian Council of Technicians and Technologists (CCTT)		**S**	**S**		**S**		**F**
China	China Association for Science and Technology (CAST)	**P**						
Chinese Taipei	Institute of Engineering Education Taiwan (IEET)	**S**	**S**					
	Chinese Institute of Engineers (CIE)				**S**		**S**	
Costa Rica	Colegio Federado de Inginieros de Costa Rica (CFIA)	**P**						
Hong Kong China	Hong Kong Institution of Engineers (HKIE)	**S**	**S**		**S**	**S**	**S**	
India	National Board of Accreditation (NBA)	**S**						
	Institution of Engineers India				**S**			
Indonesia	Institution of Engineers (PII)						**S**	
Ireland	Engineers Ireland	**S**	**S**	**S**	**S**	**S**		**F**
Japan	Japan Accreditation Board for Engineering Education (JABEE)	**S**						
	Institution of Professional Engineers Japan (IPEJ)				**S**		**S**	
Korea	Accreditation Board for Engineering Education of Korea (ABEEK)	**S**	**S**	**S**				
	Korean Professional Engineers Association (KPEA)				**S**		**S**	
Malaysia	Board of Engineers Malaysia (BEM)	**S**						
	Institution of Engineers Malaysia (IEM)				**S**		**S**	
New Zealand	Institution of Professional Engineers New Zealand (IPENZ)	**S**	**S**	**S**	**S**	**S**	**S**	**F**
Pakistan	Pakistan Engineering Council (PEC)	**P**			**P**			
Peru	The Institute of Quality and Accreditation of Programmes in Computing, Engineering and Technology Education (ICACIT)	**P**						
Philippines	Philippines Technological Council (PTC)	**P**					**S**	
Russia	Association for Engineering Education of Russia (AEER)	**S**			**P**		**S**	
Singapore	Institution of Engineers, Singapore (IES)	**S**			**S**		**S**	
South Africa	Engineering Council of South Africa (ECSA)	**S**	**S**	**S**	**S**	**S**		**F**
Sri Lanka	Institution of Engineers Sri Lanka (IESL)	**S**			**S**			
Thailand	Council of Engineers, (COE)						**S**	
Turkey	Association for Evaluation and Accreditation of Engineering Programs (MUDEK)	**S**						
UK	Engineering Council (EngC)	**S**	**S**	**S**	**S**	**S**		**F**
USA	ABET Inc	**S**	**S**	**S**				
	National Council of Examiners for Engineering and Surveying (NCEES)				**S**		**S**	

Notes

[1] Froyd et al (2012) identify the transition to science-based engineering curricula as one of five shifts in engineering education, the others being an emphasis on design, a shift to outcomes in education and accreditation, applying educational research in curricula, and integration of information, computation and communications technology in engineering education

[2] See *History of the NCEES* at ncees.org/about-ncees/the-history-of-ncees/

[3] A history of ABET is available at: www.abet.org/History/

[4] Oberst and Jones (2000) *International trends in engineering accreditation and quality assurance*

[5] See *International Accreditation* at www.abet.org/History/

[6] See: Washington Accord (1989) available at IEA History page.

[7] The concept of substantial equivalence is fundamental to all Accords and agreements: when applied to educational programmes means that two programmes, while not meeting a single set of criteria, are both acceptable as preparing their respective graduates to enter formative development toward registration. (See IEA 2011)

[8] The 1997 agreement is available at IEA History page. The current agreement is available at www.ieagreements.org/policies-and-procedures.cfm

[9] See Washington Accord (1997a)

[10] See Washington Accord 1997b). The 1997 Washington Accord Rules and Procedures are available at IEA History page.

[11] The first combined Accord Rules and Procedures (2007) are available at IEA History page.

[12] In the Accord Rules and Procedures (2014a), the requirements for admission to provisional status are listed in Section C.2 while those applicable for admission as a signatory appear in section C.4.5.

[13] The Sydney and Dublin Accord Agreement texts are in the common Accord Rules and Procedures document available at www.ieagreements.org/policies-and-procedures.cfm

[14] The body's English name Japan Consulting Engineers Association (JCEA) was changed in 2001 to Institution of Professional Engineers Japan (IPEJ) by amendment of the applicable Act in 2000.

[15] Adapted from the Preamble to the 2009 EMF Constitution.

[16] The EMF Agreement merged into the EMF Constitution and underwent revision over the period 2001-2009.

[17] The objectives follow the sequence of the 2003 EMF Constitution. Later the sequence was changed to give priority to standards setting.

[18] The EMF Agreement used the wording "… in a holistic way at the stage of admission to the international register." Revision 2 of the Graduate Attributes and Professional Competencies approved in 2009 changed the intended level to the attainment of registration in a jurisdiction.

[19] *Mutual exemption* is a process whereby one registering authority grant exemption to an applicant from processes and assessment already performed by anther authority to mutually agreed standards.

[20] See Section 12.2 of the 2009 EMF Constitution

[21] The 2005 version of the Graduate Attributes (IEA 2005) is available at IEA History page.

[22] The 2009 version of the APEC Engineer Agreement is used as reference here. See APEC (2009). The current agreement is APEC (2014). .

[23] The 2009 version of the ETMF Constitution is used a reference for this history.

[24] Miksad, R. *Breadth vs. Depth*, reporting on a statement by sixteen university deans.

[25] Rugarcia et al,. *A Vision for a New Century*

[26] Institution of Engineers Australia, (1996) *Changing the Culture: …*.

[27] Lang et al.1999, *Industry expectations of new engineeers*

[28] The 2013 version 3 of the *Graduate Attributes and Professional Competencies* is the current exemplar standard.

[29] See Hanrahan (2009) for a fuller account of the Graduate Attributes and Professional Competencies..

[30] FEIAP *Engineering Education Guidelines*

[31] See WFEO (2009) for the policy

[32] See http://www.wfeo.org/wfeo-iea-mou/, Accesssed 31 August 2015.

[33] IEA (2014b)

[34] See www.enaee.eu: In 2015 the Authorised Agencies are in Germany, France, UK, Portugal, Ireland, Russia, Turkey, Romania, Italy, Poland, Switzerland, Spain and Finland.
[35] ENAEE and IEA (2015): Best Practice in Accreditation: An Exemplar.
[36] See ENAEE (2015).
[37] Dixon: *Skills, Professional Regulation, and International Mobility in the Engineering Workforce*
[38] See IEA (2014c) for the current version.