Engineering Education: Accreditation and Mobility

by

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&

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Some Statistics

- China: 700,000
- India: 600,000
- USA: 80,000
- South Korea: 80,000
- Brazil: 40,000
- Australia: 20,000
- Japan: 20,000
- Bangladesh: 11,000
- Pakistan: 10,000

Why Accreditation

- Accreditation demonstrates an engineering program met certain standards necessary to enter engineering professions & work relevance;
- Graduates from accredited programs have access to enhanced opportunities in employment, licensure/registration, graduate education and global mobility;
- Accreditation assures that professionals have a solid educational foundation and are capable of leading the way in innovation, emerging technologies, and in anticipating the welfare and safety needs of the public;

Mobility

**Mobility** means the movement around the world of engineering professionals, capable of undertaking independent practice and having met the requirements for licensing or registration.
Who Benefits from Accreditation

- **Students** - provides global mobility, recognition & confidence;
- **Institutions** - enhances quality, prestige & global ranking;
- **Public & Government** – get quality engineering service & reputation;
- **Industry** – sourced professionally recognised engineering graduates
What is needed for Accreditation?

• National Engineering Competency Standard (NECS);

• Competency Compliant Course/Program Curriculum;

• Periodic/ regular (generally every 5 years cycle) accreditation/re-accreditation of engineering programs offered by institutions.
The Bologna Process & ENAEE

- The Bologna Process stems from the Bologna Declaration, initially signed by the Higher Education Ministers of 29 European countries in June 1999. Now 46 countries are signatories.

- A major objective of the Bologna Declaration is to promote mobility of both students and academics within Europe, by removing structural obstacles arising from differences between national systems.

- **ENAEE** - *European Network for Accreditation of Engineering Education* stemmed from Bologna Process & authorises quality assurance and accreditation within European Union & awards the EUR-ACE label to accredited engineering degree programmes.
The **Washington Accord**, signed in **1989**, is an international agreement among bodies responsible for accrediting engineering degree programs for entry to professional engineering practice.

The Washington Accord recognises the **substantial equivalence** of the graduate outcomes of programs accredited by those bodies and of the **accreditation processes** used.

**Signatories** agree to recognise graduates of programs accredited by the accreditation systems of the signatory bodies as having met the academic requirements for entry to the practice of engineering in their own jurisdiction.
<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Represented by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>1989</td>
<td>Engineers Australia (formerly IEAust)</td>
</tr>
<tr>
<td>Canada</td>
<td>1989</td>
<td>Engineers Canada</td>
</tr>
<tr>
<td>Ireland</td>
<td>1989</td>
<td>Engineers Ireland</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1989</td>
<td>Institution of Professional Engineers NZ</td>
</tr>
<tr>
<td>United Kingdom (UK)</td>
<td>1989</td>
<td>Engineering Council UK</td>
</tr>
<tr>
<td>United States (USA)</td>
<td>1989</td>
<td>Accreditation Board for Engineering and Technology (ABET)</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>1995</td>
<td>The Hong Kong Institution of Engineers</td>
</tr>
<tr>
<td>South Africa</td>
<td>1999</td>
<td>Engineering Council of South Africa (EASA)</td>
</tr>
<tr>
<td>Japan</td>
<td>2005</td>
<td>Japan Accreditation Board for Engineering Education (JABEE)</td>
</tr>
<tr>
<td>Singapore</td>
<td>2006</td>
<td>Institution of Engineers Singapore (IES)</td>
</tr>
<tr>
<td>South Korea</td>
<td>2007</td>
<td>Accreditation Board for Engineering Education of Korea (ABEEK)</td>
</tr>
<tr>
<td>Taiwan</td>
<td>2007</td>
<td>Institute of Engineering Education Taiwan (IEET)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2009</td>
<td>Board of Engineers Malaysia (BEM)</td>
</tr>
<tr>
<td>Turkey</td>
<td>2011</td>
<td>MUDEK</td>
</tr>
<tr>
<td>Russia</td>
<td>2012</td>
<td>Association for Engineering Education of Russia</td>
</tr>
<tr>
<td>India</td>
<td>2014</td>
<td>National Board of Accreditation by All India Council of Technical Education (AICTE)</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>2014</td>
<td>The Institution of Engineers, Sri Lanka</td>
</tr>
</tbody>
</table>
How did India become full Member

- NBA with Engineers Australia (IEAust)’s help developed National Generic Competency Standard.

- Upon NBA’s request, the IEA sent a review team in late 2013 and early 2014 to assess NBA’s accreditation process.

- The IEA carried out a comprehensive review & audit of NBA’s recently developed accreditation systems and practices;

- The IEA review team submitted its report in March 2014.

- In June 2014, upon receiving satisfactory reports, the IEA formally accepted India as full Member of IEA.

- Many experts from Australia, USA, India including former HRD Minister Kapil Sibal, former NBA secretary Dinesh Paliwal, and Indian Education Secretary Ashok Thakur played a key role in pushing for this prestigious Washington Accord full membership.
Indian engineering graduates' degrees to be recognised across 17 countries

NEW DELHI: Engineering graduates from India will find it easier to take advantage of international prospects as their degrees will now be recognised across 17 major countries including the United States, Japan and Australia. On Friday, India became a permanent member of the Washington Accord, an international agreement for accrediting undergraduate engineering degree programmes.

International mobility of engineering graduates from Indian Institutes of Technology (IITs) has not been an issue given the global recognition of these institutes, but this has not been the case with the graduates from the 1,300-odd other engineering colleges in the country.

With India becoming a permanent member of the Washington Accord, Indian engineering graduates will be considered to have met the academic requirements necessary to take up the practice of engineering in any of the signatory countries. The Washington Accord aims to promote mobility and quality assurance across countries. Besides recognition for Indian engineering degrees, membership of the international accreditation agreement will ensure a minimum global quality for all engineering institutions in the country.

Congratulating the officials of the human resource development ministry and the National Board of Accreditation (NBA), human resource development minister Smriti Irani said, "This will ensure highest quality assurance standards to be implemented in our technical and engineering programmes and provide global mobility to our engineering graduates. Graduates having degrees, which have been so accredited, would have substantial international equivalence of their achievement levels across the signatory nations. This will substantially enhance their employment opportunities around the world."

The decision to give India permanent membership, seven years after it acquired provisional membership, was taken at the meeting of the International Engineering Alliance in Wellington, New Zealand, on Friday. The membership is effective immediately.

This brings to a close India's 15-year quest for permanent membership. In 2000, the All India Council for Technical Education (the NBA was part of the council) initiated efforts for membership of the Washington Accord but no real progress was made.

Another attempt was made in 2003, even though India's proposal was considered fit for appraisal in June 2003, delays by the government in pursuing the case meant that India missed out being considered at the 2005 meeting of the Washington Accord members.
Provisional Members of Washington Accord as on Dec 2014

These countries qualifications are not currently professionally recognised as they do not have *National Competency Standards* and well developed accreditation process.

<table>
<thead>
<tr>
<th>Provisional Members (Washington Accord)</th>
<th>Joining Year</th>
<th>Represented by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>2006</td>
<td>Board of Accreditation for Engineering and Technical Education (BAETE)</td>
</tr>
<tr>
<td>Pakistan</td>
<td>-</td>
<td>Pakistan Engineering Council</td>
</tr>
<tr>
<td>China</td>
<td>2013</td>
<td>China Association for Science and Technology</td>
</tr>
<tr>
<td>Philippines</td>
<td>2013</td>
<td>Philippines Technological Council</td>
</tr>
<tr>
<td>Peru</td>
<td>2014</td>
<td>ICACIT</td>
</tr>
</tbody>
</table>
How to Become a Full Member

Provisional Status

- Acceptance by a two-thirds majority of signatories;
- Provisional member needs to develop NECS, criteria, policies and procedures;
- Mentoring needs to continue during provisional status.

Full Signatory

- 2 years as provisional member & once ready, provisional can apply for signatory status by requesting a verification visit;
- Application must be supported by two signatories;
- Visit must demonstrate substantial equivalence of:
  - Accreditation standard to the Graduate Attributes (NECS);
  - Policies and processes to be substantially equivalent;
- Visit report is considered at a general meeting;
- Admission of a new signatory requires unanimous approval.
1. Articulate measurable PLOs
2. Demonstrate how curriculum supports PLOs
3. Create a multi-year plan to gather evidence for each PLOs
4. Systematically collect and evaluate evidence of student learning
5. Develop recommendations for improvement
6. Improve the curriculum and pedagogy

Engineering Accreditation
Stage 1: National Generic Competency Standard
(Engineers Australia)

• Knowledge and Skill base

1.1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.
1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.
1.4. Discernment of knowledge development and research directions within the engineering discipline.
1.5. Knowledge of contextual factors impacting the engineering discipline.
1.6. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.

• Engineering Application Ability

2.1. Application of established engineering methods to complex engineering problem solving.
2.2. Fluent application of engineering techniques, tools and resources.
2.3. Application of systematic engineering synthesis and design processes.
2.4. Application of systematic approaches to the conduct and management of engineering projects.

• Professional and Personal Attributes

3.1. Ethical conduct and professional accountability
3.2. Effective oral and written communication in professional and lay domains.
3.3. Creative, innovative and pro-active demeanour.
3.4. Professional use and management of information.
3.5. Orderly management of self, and professional conduct.
3.6. Effective team membership and team leadership.
# Example: Mechanical Engineering Program

## Program Learning Outcomes

### Bachelor of Engineering

<table>
<thead>
<tr>
<th>Knowledge and Skill Base</th>
<th>AQF LODs</th>
<th>RMIT's GAs</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.</td>
<td>K1, K2</td>
<td>GA1, GA5</td>
<td>MIET2419, MANU2095</td>
<td>MIET2370, MIET2115, MIET2216</td>
<td>MIET1071, OENG1074</td>
<td>MIET1081, OENG1074</td>
</tr>
<tr>
<td>1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.</td>
<td>K1, S2</td>
<td>GA1</td>
<td>MIET2422, MATH2117</td>
<td>MATH2124, MATH2118</td>
<td>MANU2095</td>
<td>MIET2420, MIET2134</td>
</tr>
<tr>
<td>1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline.</td>
<td>S1, S2</td>
<td>GA1</td>
<td>AERO2248, MIET2422</td>
<td>MIET2370, MIET2495</td>
<td>OENG1074</td>
<td>MIET1076, OENG1074</td>
</tr>
<tr>
<td>1.4 Discernment of knowledge development and research directions within the engineering discipline.</td>
<td>S1, S2</td>
<td>GA1</td>
<td>AERO2248, MIET2495</td>
<td>OENG1074, OENG1075, OENG1074</td>
<td>MIET1076, OENG1076</td>
<td>MIET1199, OENG1074</td>
</tr>
<tr>
<td>1.5 Knowledge of contextual factors impacting the engineering discipline.</td>
<td>S1, S2</td>
<td>GA1</td>
<td>MIET2116</td>
<td>MIET1068, OENG1075</td>
<td>MIET1199, OENG1074</td>
<td>MIET1199, OENG1074</td>
</tr>
<tr>
<td>1.6 Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.</td>
<td>A1, A4</td>
<td>GA1</td>
<td>MIET2115</td>
<td>MIET1068, OENG1075</td>
<td>MIET1199, OENG1074</td>
<td>MIET1199, OENG1074</td>
</tr>
</tbody>
</table>

### Engineering Application Ability

| 2.1 Application of established engineering methods to complex engineering solving. | S1, S2   | GA1          | MIET2422, MIET2134      | MIET1071, OENG1074      | MIET1076, OENG1074     | MIET1199, OENG1074     |
| 2.2 Fluent application of engineering techniques, tools and resources.              | S2, S3   | GA1          | MIET2422, MIET2495      | OENG1074, OENG1075, OENG1074 | MIET1076, OENG1076     | MIET1199, OENG1074     |
| 2.3 Application of systematic engineering synthesis and design processes.           | S3, S4   | GA1, GA6     | AERO2248, MIET2420      | MIET1199, OENG1074      | MIET1199, OENG1074     | MIET1199, OENG1074     |
| 2.4 Application of systematic approaches to the conduct and management of engineering projects.                                           | A1, A4   | GA1          | MIET2370, MIET2116      | MIET1068, OENG1075      | MIET1199, OENG1074     | MIET1199, OENG1074     |

### Professional and Personal Attributes

| 3.1 Ethical conduct and professional accountability.                                | A1, A2   | GA1          | AERO2248, MIET2370      | MIET1199, OENG1074      | MIET1199, OENG1074     | MIET1199, OENG1074     |
| 3.2 Effective oral and written communication in professional and lay domains.       | S5, S6   | GA1          | AERO2248, MIET2495      | OENG1074, OENG1075, OENG1074 | MIET1076, OENG1076     | MIET1199, OENG1074     |
| 3.3 Creative, innovative and pro-active demeanour.                                  | A2, S3   | GA1, GA2     | MIET2422, MIET2115      | MIET1068, OENG1075      | MIET1199, OENG1074     | MIET1199, OENG1074     |
| 3.4 Professional use and management of information.                                | A4, A5   | GA1          | AERO2248, MIET2420      | MIET1199, OENG1074      | MIET1199, OENG1074     | MIET1199, OENG1074     |
| 3.5 Orderly management of self, and professional conduct.                          | A3, A4   | GA1, GA5     | AERO2248, MIET2370      | MIET1199, OENG1074      | MIET1199, OENG1074     | MIET1199, OENG1074     |
| 3.6 Effective team membership and team leadership.                                 | A3, A4   | GA1, GA5     | AERO2248, MIET2370      | MIET1199, OENG1074      | MIET1199, OENG1074     | MIET1199, OENG1074     |
Road Map to become a Full Member
(Proposed over 3 years: 2015-2018)

3 stage process involving substantial consultation and active participation of all stakeholders have been proposed:

STAGE 1: Development of Framework (Year 1)

• Development of Accreditation and Quality Framework (AQF) and National Engineering Competency Standards (NECS) to enable Bangladesh to join the Washington Accord as a full member country.

• Review the existing curriculum of selected engineering programs at two leading universities in Bangladesh to identify/measure compliance issues with the proposed NECS and framework.
STAGE 2: Initial Curriculum Development and Review (Year 2)

- Pilot development of update existing curriculum based on findings in Stage 1, with BUET (proposed) as the lead engineering university in Bangladesh.

- The modernised, internationalised coherent curriculum could act as a prototype to guide modernisation of engineering curricula across the nation.

- Review phase: Trial accreditation of new curriculum following standard processes of the AQF and NECS developed in Stage 1 consistent with the Washington Accord.

- Refine competency standard and process can finally be endorsed and approved by stakeholders (universities, IEB, UGC and Ministry of Education)
STAGE 3: Nationwide implementation (Year 3)

• Preparation of implementation roadmap, schedule, support documentation and training materials, and training of trainers for national roll-out of the new AQF and NECS to all engineering education providers in Bangladesh.

• Training period (by IEB in collaboration as required with EA and RMIT/Monash universities).

• Establishment of on-going continued mentoring and participation by Engineers Australia and Australian universities as regular observers in the accreditation of Bangladeshi engineering qualifications, until Bangladesh attains full membership of Washington Accord.
Summary

- For globalisation and mobility, engineering graduates need globally recognised accredited qualifications;
- Bangladesh needs to develop **National Engineering Competency Standard (NECS)** for engineering programs;
- Bangladesh can adopt EA, IES or HK IE Stage 1 Competency with some modifications to accommodate local needs and accreditation practices;
- Bangladesh must seek assistance from Washington Accord signatory members especially Australia, New Zealand, Hong Kong & Singapore due to their high standards, practices, & close friendly relation with Bangladesh;
- Assistance from new members such as Malaysia, India, Sri Lanka can also be sought.
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Engineering education in Bangladesh - an indicator of economic development

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Thank You