

RESTRICTED

Professional Accreditation Handbook (Engineering Degrees)

Revised by authority of the Accreditation Board as of February 2013

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1. PROFESSIONAL ACCREDITATION

1.1 Introduction

The Hong Kong Institution of Engineers (the HKIE) is the professional engineering learned society and qualifying body for Hong Kong and as such has a responsibility for setting and maintaining the professional and technical standards of its members. To this end, it evaluates the qualifications for admission to grades of Institution membership.

The academic qualification for Corporate Membership of the HKIE is an accredited engineering degree at the honours level. The HKIE's process of accrediting such programmes is called professional accreditation. (A description of professional accreditation is provided in the Appendix.) This handbook sets out the HKIE's processes, mechanisms and criteria for the professional accreditation of engineering degree programmes.

The Institution would like to emphasise that accreditation is a collaborative activity between the profession and the academic institutions. It does not view the accreditation of engineering degree programmes as discrete and limited exercises, but as part of a process to work with the universities on a continuous basis, to provide help, advice and support, to ensure that the quality of engineering degree programmes is high and meets the needs of professional engineers, their employers and Hong Kong society in general.

The HKIE takes very seriously its responsibilities with regard to the Washington Accord and to fostering, maintaining and developing bilateral and international agreements for the mutual recognition of qualifications. This is undertaken through links with a number of international engineering initiatives which have been established to harmonise qualifications and to recognise accreditation methods and standards; the Washington Accord, Federation of Engineering Institutions of South East Asia and the Pacific (FEISEAP) and European Federation of National Engineering Associations (FEANI) are examples.

1.2 Accreditation by Faculty

Essentially, the HKIE is concerned with the standards and quality of individual engineering degree programmes. Consequently, it is the individual programme which receives accreditation. However, the process of professional accreditation also considers the appropriate Faculty in terms of its overall philosophy, objectives and resources. This has the advantage of taking into account the broad principles and policies of the development of engineering education in a university.

Furthermore, consideration of a range of programmes has particular advantages in relation to modular programmes and ones containing a number of elective courses.

Although visits will normally be by Faculty, there may be visits to individual departments within a Faculty for the purposes of provisional accreditation, to consider major modifications to a programme or to monitor a programme which had been

granted accreditation for less than the normal five years.

1.3 Initiation of Accreditation Exercises

The professional accreditation of engineering degree programmes in the universities is normally initiated by a university issuing an invitation to the HKIE's Accreditation Board to carry out appropriate accreditation exercises.

1.4 Consultation and Accreditation Visits

As mentioned in the introduction, the HKIE sees accreditation exercises as a continuous activity. Accordingly, any university planning new engineering degree programmes, or restructuring existing ones, is encouraged to consult the HKIE in order to ensure that the engineering degree programmes are developed such that the requirements of all concerned are fully addressed.

1.5 Provisional and Full Accreditation

The HKIE undertakes provisional accreditation exercises to consider programmes which have yet to produce the first cohort of graduates, and, full accreditation exercises for the consideration of existing programmes, whether they have been previously accredited or not.

1.6 Accreditation Decisions and the Accreditation Cycle

The HKIE can reach four accreditation decisions as follows:

- a. the programme be granted provisional accreditation with or without conditions;
or
- b. the programme be granted accreditation for a term of up to five years with or without conditions; or
- c. the programme not be granted accreditation; or
- d. the accreditation of the programme be revoked.

1.6.1 Provisional Accreditation

Provisional accreditation may be granted to developing programmes with or without conditions, and generally the relevant accreditation exercises will be completed during the second-half of the programme of the first cohort of intake. Provisional accreditation provides an indication to both the university and prospective students that the programme is well structured and has very good possibilities of receiving full

accreditation but should not be construed as a commitment to the granting of full accreditation.

1.6.2 Accreditation for a Period of up to Five Years

The HKIE may grant full accreditation for the normal cycle of accreditation of five years. Alternatively, the HKIE may grant full accreditation for a term of less than five years, either to bring it in line with the accreditation cycle of other programmes or to monitor a programme early in relation to any conditions, requirements and/or concerns which may have emerged during the accreditation process.

For a newly developed programme, a full accreditation exercise is mounted, at a time agreed with the university, after the first cohort of graduates is produced. Full accreditation, if granted, will be retrospective so as to apply to the first cohort of graduates.

1.6.3 Accreditation Refused or Withdrawn

If a programme is substantially at variance with the HKIE criteria (see section 2), then the accreditation can be refused or withdrawn.

1.6.4 Revocation of Accreditation

If a university fails to meet conditions imposed on a programme by the previous accreditation or if it has introduced changes which make the programme seriously at variance with the HKIE criteria, then the accreditation can be terminated.

1.7 The Accreditation Panel

The HKIE Accreditation Panel (not to be confused with visiting teams) is a group of appropriately qualified senior members, appointed by the HKIE Accreditation Board, to participate in professional accreditation exercises, on behalf of the HKIE.

In addition, professional engineers from overseas, with appropriate expertise are invited by the Accreditation Board to be included on the Panel.

1.8 Visiting Teams

Visiting teams shall be selected from the Panel for each particular accreditation exercise. Team members are selected on the basis of their expertise and that they have no professional or any other association with the university, nor do they have family members attending it. Team members should declare that they have no conflict of interest when taking up the appointments. The Dean or Head of Department shall be informed of the names of the proposed chairman and members of the team, and objection to team members may be made if they feel there is a conflict of interest.

1.8.1 Team Size and Constitution

For a single discipline exercise, the team shall normally comprise four members including the chairman. All members shall be experienced in the discipline, or associated with it. For exercises involving two or more programmes, which may cover several engineering disciplines, there shall be at least two members from, or associated with, each of the disciplines.

For each accreditation exercise, the Accreditation Board will also appoint one of its members, who can join the accreditation visit as an observer, to act as an assessor. The assessor will study all the documentation and, in consultation with the visiting team chairman, make recommendations to the Board for an accreditation decision.

The accreditation visiting team shall have a proper mix of academics and practising professional engineers. All the team members shall have training/ briefing on professional accreditation, and the majority of them will also have prior experience in professional accreditation. To ensure continuity and expertise, the team chairman shall have considerable previous experience in professional accreditation.

Whenever possible, members of the Accreditation Board shall be invited to participate in the visits. In addition, the HKIE secretariat staff shall accompany the visiting team.

1.9 Accreditation Visits

Accreditation visits are an important part of an accreditation exercise. They enable the HKIE to assess, at first hand, qualitative factors, such as facilities, intellectual environment, morale, professional attitudes and the quality of staff and students.

For programmes which are being planned by a university, the HKIE will arrange consultation visits by experts as appropriate in each case. On such visits, the experts shall only comment and advise on the proposed programmes and shall not commit the HKIE to granting accreditation to a programme.

It should be noted that the accreditation visit is only a part of the full accreditation exercise. There is considerable preparation prior to a visit and work to be done after the visit.

A visit will normally take one and a half days and shall include:

- meetings of the team with the appropriate senior university staff;
- meetings with the programme leader and other academic staff;
- meetings with the students and support staff;
- visit to the departmental facilities, including lecture theatres, laboratories, library and computing facilities;

- review examination papers and examination scripts, laboratory instructions, reports and design assignments, project reports and other material demonstrating student performance;
- private meetings of the team; and
- an exit meeting with the Dean and senior staff to convey the team's initial observations.

1.10 Accreditation Reports

At the end of a visit, the team chairman, with the assistance of the HKIE secretariat, shall draft a formal report based on a consensus of opinion and the observations of the team, and assess whether the programme conforms to the HKIE Accreditation Criteria.

The following procedures have been adopted by the Accreditation Board in dealing with the Accreditation Report.

- (i) The visiting team chairman will draft the report with the assistance of members of the team and the HKIE staff.
- (ii) The draft report will be sent to the visiting team members for comment.
- (iii) The comments made by the members of the visiting team will be considered by the chairman.
- (iv) The draft report will then become the final report.
- (v) The final report will be sent to the Dean and relevant Heads of Departments for comment.
- (vi) The comments made by the Dean and Heads will be sent to the visiting team chairman and the assessor.
- (vii) The final report, and the comments made by the Dean and Heads will be submitted to the Accreditation Board at the decision meeting.

The HKIE maintains strict confidentiality regarding accreditation matters. It is for the university to decide how information related to this accreditation should be released and may inform HKIE accordingly.

1.11 Accreditation Decisions

The Chairman of the Board will initiate the discussion on the programme under consideration.

The accreditation report and university responses, and all other relevant information and correspondence will be passed to the Board for a decision.

The representatives of the university concerned, usually the Dean and/or Head of Department may attend that part of Board meeting devoted to the presentation of the report. Members of the visiting team may also be present.

At the meeting, the visiting team chairman will present the report and representatives of the university may put forward further information and answer questions of fact.

The Board will then conduct a private meeting from which University representatives are excused. The assessor will present recommendations. The Board may then make decisions on the programme.

The Secretary to the Board will write to inform the university of the decision with a copy of the final report, in confidence, to the university Vice Chancellor/President/Director, copied to the relevant Dean and Head of Department.

1.12 Costs

Any university having its engineering programmes on the HKIE list of accredited degrees shall pay a fee to the HKIE in April of each year. The fee will be based on the number of undergraduate engineering degree programmes of the university and shall be agreed by the concerned parties.

The direct costs of each accreditation exercise (travel, subsistence, accommodation) will be paid by the university concerned.

1.13 Confidentiality

All documents and other information obtained by the Accreditation Board during the course of an exercise are kept confidential.

1.14 Appeal Procedures

In the event of a decision by the Accreditation Board to refuse or terminate accreditation of an engineering degree programme, the university concerned has the right to appeal to the President of the Institution to review the decision.

1.15 Publication

A full list of accredited programmes and their period of accreditation is published on the HKIE website.

2. CRITERIA FOR THE ACCREDITATION OF ENGINEERING DEGREE PROGRAMMES

2.1 Introduction

The HKIE undertakes professional accreditation to evaluate the standard and quality of engineering degree programmes. In doing so it takes into account a number of factors about the programmes and the universities which offer them. The quality of an engineering degree programme depends on more than just the curriculum and syllabus. The quality of the graduates is an important consideration in the evaluation of an engineering programme. The degree programme must define outcomes that they expect of their graduates consistent with their educational objectives and the needs of the discipline; and describe the processes that are used to measure and evaluate these outcomes. In addition, the calibre of the academic staff, the entry standards, staffing levels, teaching methods, facilities, funding and method of assessment are just some of the factors which influence the quality of the educational experience and the outcomes.

The following describes broad criteria which are used by the HKIE regarding appropriate engineering degree programmes for the profession. In setting them out, the HKIE considers it important, both in the context of educational and professional objectives, for universities to encourage an environment which can accommodate innovative educational developments and to allow for the expression of the university's individual strengths, qualities and ideals.

2.2 Standards

The HKIE seeks to conform with internationally recognised standards in terms of accreditation processes and outcomes.

2.3 Aims and Objectives

In its submission for accreditation of an engineering degree programme, a university should be able to express the aims, objectives and ethos of the programme both in relation to the appropriate standards of degree level education and the requirements of the profession. The university should demonstrate how its programmes meet the aims and objectives, and how they can respond to future developments.

The HKIE appreciates that engineering degree programmes are dynamic entities which must evolve with technology and the changing needs of the profession and society. Consequently, the HKIE expects a university to be able to articulate such developments in terms of how the structure and rationale of its programmes can respond to change. Based on generally accepted norms, engineering programmes must demonstrate that their graduates have the following attributes:

- (a) an ability to apply knowledge of mathematics, science, and engineering appropriate to the degree discipline

- (b) an ability to design and conduct experiments, as well as to analyse and interpret data
- (c) an ability to design a system, component or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate and solve engineering problems
- (f) an ability to understand professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) an ability to understand the impact of engineering solutions in a global and societal context, especially the importance of health, safety and environmental considerations to both workers and the general public
- (i) an ability to stay abreast of contemporary issues
- (j) an ability to recognize the need for, and to engage in life-long learning
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice appropriate to the degree discipline
- (l) an ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations

The interpretation of the above graduate attributes should be consistent with the requirements of the Washington Accord, including the level of problem solving and range of engineering activities and a copy of the Graduate Attributes and Professional Competencies is enclosed as Appendix in this Handbook.

2.4 Duration

The HKIE believes that engineering degree programmes should have a minimum duration of four years full-time equivalent, of which a one-year full-time equivalent consists normally of about 26 weeks of classroom, laboratory, workshop and related activities. (Time allocated to assessment, field work and practical training fall outside these 26 weeks.)

The criteria set out here provide broad guidance for a four year full-time equivalent programme. It is accepted that a longer programme than this will enable an academic institution to introduce subjects and activities which could contribute further to the education of an engineering undergraduate, but the onus is on the university to demonstrate that the programme contains at least the equivalent of the four years which meets the HKIE's requirements. When technology based delivery of content is used the university must demonstrate the equivalence of this method with traditional delivery methods.

2.5 Part-time Engineering Degree Programme

If a part-time engineering degree programme is offered, or if a student undertakes a programme on a part-time basis, all requirements of an accredited programme must be met.

2.6 Syllabus and Curriculum

The HKIE does not wish to impose uniformity on universities in relation to curricula and syllabuses, but encourages them to develop courses, making the best use of resources, responding to academic and technological change, and recognising the needs of the students, community and profession. Nevertheless, the HKIE does require course content to be sufficient to enable undergraduates to acquire, within the duration of a programme, the basic knowledge, understanding and skills necessary to enable them to practise in an effective and professional manner as a graduate engineer. Course sequences in the curriculum must provide for breadth and depth appropriate to the discipline, and the University must demonstrate that prerequisites are followed.

The HKIE accepts that over the whole range of the engineering disciplines it is not possible to state precisely the essential characteristics and content of courses and programmes. However, the Institution expects the curricula to prepare students in a broad range of engineering subjects, mathematics and complementary support subjects, appropriate to the degree discipline. The Institution considers that these would normally include (a) one year of mathematics and basic sciences, (b) at least two years of engineering topics, including engineering sciences and engineering design and, (c) complementary studies that support the professional nature of the curriculum. A description of each is given below to provide guidance, but is not considered to be all inclusive. The programme must ensure that its curriculum is consistent with the prescribed outcomes and objectives. The presence of each of the above elements in the curriculum is not sufficient evidence that the graduates have the outcomes that the programme desires.

2.6.1 Mathematics and Basic Sciences

The HKIE considers that the mathematics content of degrees should underpin the engineering subjects, and should emphasise mathematical concepts, and principles, numerical analyses and applications and their relationship to the modelling of engineering systems. It is accepted that these can be delivered as separate topics, however, the HKIE believes that it is also desirable for mathematics to be delivered within the context of its application in engineering situations and be within the engineering subjects of the programme.

The HKIE regards basic sciences as the foundation of engineering sciences and are indispensable parts of an engineering programme. Basic sciences include physics, chemistry, biology and other science subjects that are relevant to a particular field of study.

2.6.2 Engineering Subjects

a. Engineering Sciences

Engineering sciences have their roots in mathematics, physics and other

basic sciences, but carry knowledge further towards creative application. This should start with a systematic, theory based understanding of natural sciences and may include such subjects as mechanics of solids, fluid mechanics, thermodynamics, electrical and electronic circuits, computer science, materials science, soil mechanics, aerodynamics, control systems, transport, and so on depending on the discipline.

In an engineering degree programme, the HKIE expects a university to provide engineering courses for the appropriate discipline, and others which provide an appreciation of related disciplines, to support the educational objectives and outcomes desired. In this connection, engagement with selected knowledge in the research literature of the Discipline(s) is expected.

b. Engineering Design and Synthesis

The HKIE believes the importance of design and synthesis is such that a separate appropriate topic should be established. However, it is accepted that because of the applied nature of this activity to almost every engineering endeavour it could be delivered within the engineering science courses in a programme. Its establishment as a separate topic can be used to demonstrate that it is a creative, iterative and often open-ended process and to also enable discussion of general design techniques and philosophy, as well as financial, quality, safety and environmental implications.

c. Health, Safety and the Environment

The programme should demonstrate the importance of health, safety and environmental considerations to both workers and the general public.

d. Laboratory and Field Work

Courses should be supported by meaningful laboratory work, well co-ordinated with the lecture material and supported with relevant up-to-date equipment. If a university utilises laboratories at different locations or uses different delivery formats, they must provide evidence to show that every student receives a laboratory experience that is meaningful, well co-ordinated, and up-to-date.

Residential field courses in subjects such as surveying and geology are considered important where these subjects are an integral part of the programme.

e. Project

The HKIE believes that project work is an important means of introducing engineering approach to solution of problems. For this reason, the extensive use of projects is expected in every engineering

degree programme. Normally, the final year of the programme should include an intellectually challenging project which is individually assessed. The project should involve design, synthesis, application and/or creativity. The assessment of the project should have a significant weighting in the degree classification.

2.6.3 Complementary Studies

Studies which provide an appreciation of those wider issues which enable engineers to practise professionally in society should be fully integrated within the programme. Such studies may include management, economics, law, history, finance or a foreign language. Furthermore, the following elements should be included in the curriculum.

a. Practical Training

The HKIE recognises the benefits of practical experience obtained during an engineering degree programme and recommends that students aggregate significant, relevant practical training or employment. This will normally be obtained during vacations or in a "sandwich" year, and universities should encourage this activity.

b. Communications

The HKIE cannot over emphasise the need for professional engineers to have good communication skills. Engineering degree programmes should contain instruction in both oral and written communication skills as well as presentation skills.

c. The Professional Engineer

It is considered that students should be introduced to the role of the professional engineer in practice and their responsibilities towards the profession, colleagues, employers, clients and the public, particularly with reference to the impact of technology on society and with regard to ethical behaviour. Furthermore, they should be made aware of the role of the engineering institutions and matters of professional practice such as licensing and registration.

They should also be encouraged to become student members of the HKIE and to take part in its activities.

2.7 Academic Staff

An important factor in determining the standard of an engineering degree programme is the quality and commitment of the teaching staff. The programme must demonstrate that they have academic staff consistent with delivering the

educational objectives and outcomes desired. The qualifications and number of staff is a necessary, but not sufficient criteria in establishing the appropriateness of the teaching cadre.

2.8 Resources

Engineering degree programmes rely on the satisfactory provision of technical and administrative staff, administration, laboratories, information services, computing facilities, finance and other resources as follows:

2.8.1 Support Staff

There should be sufficient number of technical and workshop staff with adequate qualifications and experience to ensure the smooth and safe management of laboratories, maintenance of equipment and to provide general support.

There should also be sufficient number of administrative and secretariat staff to support the academic staff.

2.8.2 Accommodation and Equipment

There must be adequate provision of lecture rooms, laboratories, workshops, drawing offices and private study areas to support the programme of lectures, tutorials and practical classes. Laboratories should be well equipped with adequate and modern equipment and should provide a safe working environment for the students.

2.8.3 Computing Facilities

Computing facilities should be consistent with the aim of using computers as part of the engineering education experience. These facilities must be appropriate for laboratory work and engineering applications such as modelling and simulation and computer aided design.

Students should have easy and adequate access to such facilities.

2.8.4 Information Services

The university should provide adequate resources for information services which include conventional and up-to-date methods and facilities for example, books, journals, tapes, films, disks and databases, and the Internet.

Conventional library facilities should provide a range and variety of technical and non-technical books, and a comprehensive range of journals covering all engineering disciplines. The inter-library loan system should be available to all students, together with abstract and

literature search facilities for project work. Students should have easy and adequate access to these facilities.

2.8.5 Financial Resources

There should be adequate financial resources to ensure the smooth operation of the department, the provision and maintenance of laboratories, computers, libraries and other support facilities as well as for the development of the staff, programmes, courses and the upgrading of equipment.

2.9 Assessment

Assessment of student performance should demonstrate the effectiveness of the learning process in achieving the programme outcomes.

The HKIE believes that there should be an effective internal quality assurance system which is essential to maintain the academic standards of programmes. In addition, there should be an independent quality assurance system such as an external examiner system or equivalent.

2.10 Entry Levels

The HKIE does not prescribe minimum qualifications for entry to engineering degree programmes, but it does expect that the selection criteria are consistent with the majority of students being able to complete the programme at the expected standard.

The programme must demonstrate that the selection procedures in place are consistent with the selection criteria and the expected outcomes.

2.11 Development

The HKIE believes it is incumbent on an academic institution to be sensitive to the requirements of society and the profession, and consequently, to develop programmes to respond to local and international requirements and to provide opportunities for staff to be able to develop their skills so that they can deliver programmes meeting local and international professional and academic standards. In order to do this, the HKIE believes that universities have a responsibility to liaise with the engineering profession and industry in relation to engineering degree programmes and their development.

2.12 Programme Amendments

It is expected that from time to time there will be evolutionary changes to a programme within the period of its accreditation. Any modification to a programme

should maintain the spirit of the programme as accredited and may include such changes as:

- a change in the title of the programme;
- a change in the length of the programme;
- the addition of options and/or streams;
- the deletion of some subjects;
- a significant change in the provision of resources for the programme.

The university should inform the HKIE of the above and other major curriculum or operational changes. The Board may then consider any subsequent actions including initiation of a visit or request of a written report.

3. ACCREDITATION SUBMISSIONS

When preparing a submission for professional accreditation, the university is advised to consider the criteria in section 2 carefully, and to consult the HKIE as appropriate.

3.1 Provisional or Full Accreditation

The information requested in the following sections relates to both provisional and full accreditation submission.

For the provisional accreditation of developing programmes the process should normally commence at least six months before the first cohort of intake has reached the half way stage of the programme, at which time a university should provide the preliminary details (section 3.2).

For the full accreditation of existing programmes, a university should submit the preliminary details no later than six months before the expiry of the current approval.

For the full accreditation of developing programmes the exercises may commence at a date, mutually acceptable to the HKIE and the university, after the first cohort of graduates has emerged. The preliminary details should be submitted no later than six months before the visit.

In both cases, the full information requested (section 3.3) should be submitted at least six weeks before the date of any visit. If as a result of considering the submission further information is required, the chairman of the HKIE's Accreditation Board, in consultation with the chairman of the visiting team and the university may arrange to delay the timing of any visit or, in exceptional circumstances the cancellation of the exercises.

3.2 Preliminary Details

A university seeking accreditation of a programme is required to submit the following preliminary details:

1. title of the Faculty or Department;
2. names, qualifications and date of appointments of Dean and Heads of Department;
3. title of the programme;
4. name of programme leader;
5. accreditation sought (provisional or full);
6. brief resume, 100 words maximum, about the programme submitted;

7. provisional dates for the visit.

Upon receiving the preliminary details, HKIE will contact the university seeking further information and/or providing further directions related to the full submission.

3.3 Full Information

Submission of full information for accreditation should be made by completing the questionnaire contained in the HKIE standard submission format. Softcopies of the questionnaire are available from HKIE upon request. Copies of the completed questionnaire are to be provided at least six weeks before the date of a visit. The questionnaire is set out as follows:

Part 1: General information related to the university/institution

Part 2: General information related to the department

Part 3: Information related to the engineering programme – general

Part 4: Information related to the engineering programme – criteria specific

3.4 Information to be Available During the Visit

The following materials and representative samples of student work that reveal the spectrum of educational outcome are to be made available during the accreditation visit:

1. Evidence of process used to identify educational objectives.
2. Evidence of process used to identify programme outcomes.
3. Evidence regarding students' achievement of the intended learning outcomes at various stages of the programme. This may include student's work, e.g. examination papers; marked examination scripts; examples of final year projects, laboratory reports; external evaluation etc.
4. Evidence of process used to improve the educational system of the programme including changes that have been made and/or proposed.

NOMENCLATURE

Academic Accreditation

Evaluation or assessment to determine whether the academic standards of an institution of higher education are comparable with internationally recognised standards. It includes course validation, course revalidation, institutional review and institutional accreditation.

Professional Accreditation

The evaluation and comparison of the academic standards of a degree or sub-degree programme and consideration of the appropriateness of the education component of that degree or sub-degree programme for professional practice.

The Accreditation Panel

Those Members of the Institution who are appointed to carry out professional accreditation visits on behalf of the HKIE.

The Accreditation Exercise

The full professional accreditation process.

The Accreditation Visit

A visit to an academic institution as an integral part of the professional accreditation exercise.

The Visiting Team

Members of the Accreditation Panel selected to carry out a specific accreditation exercise.

Programme

Refers to the complete curriculum of a degree, comprising courses/modules/credit units, assignments, workshops, projects and so on.

Course

Refers to a specific taught part of a degree programme (course is sometimes used to describe a whole degree programme, where that programme has a fixed curriculum). Courses are sometimes referred to as subjects, modules or credit units.

International Engineering Alliance

Washington Accord
Sydney Accord
Dublin Accord

Engineers Mobility Forum
Engineering Technologists
Mobility Forum

Graduate Attributes and Professional Competencies

Version 2 - 18 June 2009

Executive Summary

Several accrediting bodies for engineering qualifications have developed outcomes-based criteria for evaluating programmes. Similarly, a number of engineering regulatory bodies have developed or are in the process of developing competency-based standards for registration. Educational and professional accords for mutual recognition of qualifications and registration have developed statements of graduate attributes and professional competency profiles. This document presents the background to these developments, their purpose and the methodology and limitations of the statements. After defining general range statements that allow the competencies of the different categories to be distinguished, the paper presents the graduate attributes and professional competency profiles for three professional tracks: engineer, engineering technologist and engineering technician.

1 Introduction

Engineering is an activity that is essential to meeting the needs of people, economic development and the provision of services to society. Engineering involves the purposeful application of mathematical and natural sciences and a body of engineering knowledge, technology and techniques. Engineering seeks to produce solutions whose effects are predicted to the greatest degree possible in often uncertain contexts. While bringing benefits, engineering activity has potential adverse consequences. Engineering therefore must be carried out responsibly and ethically, use available resources efficiently, be economic, safeguard health and safety, be environmentally sound and sustainable and generally manage risks throughout the entire lifecycle of a system.

Typical engineering activity requires several roles including those of the engineer, engineering technologist and engineering technician, recognized as professional registration categories in many jurisdictions¹. These roles are defined by their distinctive competencies and their level of responsibility to the public. There is a degree of overlap between roles. The distinctive competencies, together with their educational underpinnings, are defined in sections 4 to 6 of this document.

The development of an engineering professional in any of the categories is an ongoing process with important identified stages. The first stage is the attainment of an *accredited educational qualification*, the graduate stage. The fundamental purpose of *engineering education* is to build a knowledge base and attributes to enable the graduate to continue learning and to proceed to formative development that will develop the competencies required for independent practice. The second stage, following after a period of formative development, is *professional registration*. The fundamental

¹ The terminology used in this document uses the term *engineering* as an activity in a broad sense and *engineer* as shorthand for the various types of professional and chartered engineer. It is recognized that *engineers*, *engineering technologists* and *engineering technicians* may have specific titles or designations and differing legal empowerment or restrictions within individual jurisdictions.

purpose of formative development is to build on the educational base to develop the competencies required for independent practice in which the graduate works with engineering practitioners and progresses from an assisting role to taking more individual and team responsibility until competence can be demonstrated at the level required for registration. Once registered, the practitioner must maintain and expand competence.

For engineers and engineering technologists, a third milestone is to qualify for the *international register* held by the various jurisdictions. In addition, engineers, technologists and technicians are expected to maintain and enhance competency throughout their working lives.

Several international accords provide for recognition of graduates of accredited programmes of each signatory by the remaining signatories. The Washington Accord (WA) provides for mutual recognition of programmes accredited for the engineer track. The Sydney Accord (SA) establishes mutual recognition of accredited qualifications for engineering technologist. The Dublin Accord (DA) provides for mutual recognition of accredited qualifications for engineering technicians. These accords are based on the principle of substantial equivalence rather than exact correspondence of content and outcomes. This document records the signatories' consensus on the attributes of graduates for each accord.

Similarly, the Engineers Mobility Forum (EMF) and the Engineering Technologists Mobility Forum (ETMF) provide mechanisms to support the recognition of a professional registered in one signatory jurisdiction obtaining recognition in another. The signatories have formulated consensus competency profiles for the registration and these are recorded in this document. While no mobility forum currently exists for technicians, competency statements were also formulated for completeness and to facilitate any future development.

Section 2 give the background to the graduate attributes presented in section 5. Section 3 provides background to the professional competency profiles presented in section 6. General range statements are presented in section 4. The graduate attributes are presented in section 5 while the professional competency profiles are defined in section 6. Appendix A defines terms used in this document. Appendix B sketches the origin and development history of the graduate attributes and professional competency profiles.

2 Graduate Attributes

2.1 Purpose of Graduate Attributes

Graduate attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practise at the appropriate level. The graduate attributes are exemplars of the attributes expected of graduate from an accredited programme. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary by a range indication appropriate to the type of programme.

The graduate attributes are intended to assist Signatories and Provisional Members to develop outcomes-based accreditation criteria for use by their respective jurisdictions. Also, the graduate attributes guide bodies developing their accreditation systems with a view to seeking signatory status.

Graduate attributes are defined for educational qualifications in the engineer, engineering technologist and engineering technician tracks. The graduate attributes serve to identify the distinctive characteristics as well as areas of commonality between the expected outcomes of the different types of programmes.

2.2 Limitation of Graduate Attributes

Each signatory defines the standards for the relevant track (engineer, engineering technologist or engineering technician) against which engineering educational programmes are accredited. Each

educational level accord is based on the principle of *substantial equivalence*, that is, programmes are not expected to have identical outcomes and content but rather produce graduates who could enter employment and be fit to undertake a programme of training and experiential learning leading to professional competence and registration. The graduate attributes provide a point of reference for bodies to describe the outcomes of substantially equivalent qualification. The graduate attributes do not, in themselves, constitute an “international standard” for accredited qualifications but provide a widely accepted common reference for bodies to describe the outcomes of substantially equivalent qualifications.

The term graduate does not imply a particular type of qualification but rather the exit level of the qualification, be it a degree or diploma.

2.3 Scope and Organisation of Graduate Attributes

The graduate attributes are organized using twelve headings shown in section 5.2. Each heading identifies the differentiating characteristic that allows the distinctive roles of engineers, technologists and technicians to be distinguished by range information.

For each attribute, statements are formulated for engineer, engineering technologist and engineering technician using a common stem, with ranging information appropriate to each educational track. For example, for the Knowledge of Engineering Sciences attribute:

Common Stem: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization ...

Engineer Range: ... to the solution of complex engineering problems.

Engineering Technologist Range: ... to defined and applied engineering procedures, processes, systems or methodologies.

Engineering Technician Range: ... to wide practical procedures and practices.

The resulting statements are shown below for this example:

... for Washington Accord Graduate	... for Sydney Accord Graduate	... for Dublin Accord Graduate
Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to defined and applied engineering procedures, processes, systems or methodologies.	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to wide practical procedures and practices.

The range qualifier in several attribute statements uses the notions of *complex engineering problems*, *broadly-defined engineering problems* and *well-defined engineering problems*. These shorthand level descriptors are defined in section 4.

The attributes are chosen to be universally applicable and reflect acceptable minimum standards and be capable of objective measurement. While all attributes are important, individual attributes are not necessarily of equal weight. Attributes are selected that are expected to be valid for extended periods and changed infrequently only after considerable debate. Attributes may depend on information external to this document, for example generally accepted principles of ethical conduct.

The full set of graduate attribute definitions are given in section 5.

2.4 Contextual Interpretation

The graduate attributes are stated generically and are applicable to all engineering disciplines. In interpreting the statements within a disciplinary context, individual statements may be amplified and given particular emphasis but must not be altered in substance or individual elements ignored.

2.5 Best Practice in Application of Graduate Attributes

The attributes of Accord programmes are defined as a *knowledge profile*, an indicated volume of learning and the attributes against which graduates must be able to perform. The requirements are stated without reference to the design of programmes that would achieve the requirements. Providers therefore have freedom to design programmes with different detailed structure, learning pathways and modes of delivery. Evaluation of individual programmes is the concern of national accreditation systems.

3 Professional Competency Profiles

3.1 Purpose of Professional Competency Profiles

A professionally or occupationally *competent person* has the attributes necessary to perform the activities within the profession or occupation to the standards expected in independent employment or practice. 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.

Professional competence can be described using a set of attributes corresponding largely to the graduate attributes, but with different emphases. For example, at the professional level, the ability to take responsibility in a real-life situation is essential. Unlike the graduate attributes, professional competence is more than a set of attributes that can be demonstrated individually. Rather, competence must be assessed holistically.

3.2 Scope and Organisation of Professional Competency Profiles

The professional competency profiles are written for each of the three categories: engineer, engineering technologist and engineering technician at the point of registration². Each profile consists of thirteen elements. Individual elements are formulated around a differentiating characteristic using a stem and modifier, similarly to the method used for the graduate attributes described in section 2.3.

The stems are common to all three categories and the range modifiers allow distinctions and commonalities between categories to be identified. Like their counterparts in the graduate attributes, the range statements use the notions of complex engineering problems, broadly-defined engineering problems and well-defined engineering problems defined in section 4.1. At the professional level, a classification of engineering activities is used to define ranges and to distinguish between categories. Engineering activities are classified as *complex*, *broadly-defined* or *well-defined*. These shorthand level descriptors are defined in section 4.2.

3.3 Limitations of Professional Competency Profile

As in the case of the graduate attributes, the professional competency profiles are not prescriptive in detail but rather reflect the essential elements that would be present in competency standards.

The professional competency profiles do not specify performance indicators or how the above items should be interpreted in assessing evidence of competence from different areas of practice or for different types of work. Section 3.4 examines contextual interpretation.

² Requirements for the EMF and ETMF International Registers call for enhanced competency and responsibility.

Each jurisdiction may define *performance indicators*, that is actions on the part of the candidate that demonstrate competence. For example, a design competency may be evidenced by the following performances:

- 1: *Identify and analyse design/ planning requirement and draw up detailed requirements specification*
- 2: *Synthesise a range of potential solutions to problem or approaches to project execution*
- 3: *Evaluate the potential approaches against requirements and impacts outside requirements*
- 4: *Fully develop design of selected option*
- 5: *Produce design documentation for implementation*

3.4 Contextual Interpretation

Demonstration of competence may take place in different areas of practice and different types of work. Competence statements are therefore discipline-independent. Competence statements accommodate different types of work, for example design, research and development and engineering management by using the broad phases in the cycle of engineering activity: problem analysis, synthesis, implementation, operation and evaluation, together the management attributes needed. The competence statements include the personal attributes needed for competent performance irrespective of specific local requirements: communication, ethical practice, judgement, taking responsibility and the protection of society.

The professional competency profiles are stated generically and are applicable to all engineering disciplines. The application of a competency profile may require amplification in different regulatory, disciplinary, occupational or environmental contexts. In interpreting the statements within a particular context, individual statements may be amplified and given particular emphasis but must not be altered in substance or ignored.

3.5 Mobility between Professional Categories

The graduate attributes and professional competency for each of three categories of engineering practitioner define the benchmark route or vertical progression in each category. This document does not address the movement of individuals between categories, a process that usually required additional education, training and experience. The graduate attributes and professional competencies, through their definitions of level of demand, knowledge profile and outcomes to be achieved, allow a person planning such a change to gauge the further learning and experience that will be required. The education and registration requirements of the jurisdiction should be examined for specific requirements.

4 Common Range and Contextual Definitions

4.1 Range of Problem Solving

	Attribute	Complex Problems	Broadly-defined Problems	Well-defined Problems
1	Preamble	Engineering problems which cannot be resolved without in-depth engineering knowledge, much of which is at, or informed by, the forefront of the professional discipline, and have some or all of the following characteristics:	Engineering problems which cannot be pursued without a coherent and detailed knowledge of defined aspects of a professional discipline with a strong emphasis on the application of developed technology, and have the following characteristics	Engineering problems having some or all of the following characteristics:
2	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues	Involve a variety of factors which may impose conflicting constraints	Involve several issues, but with few of these exerting conflicting constraints
3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models	Can be solved by application of well-proven analysis techniques	Can be solved in standardised ways
4	Depth of knowledge required	Requires research-based knowledge much of which is at, or informed by, the forefront of the professional discipline and which allows a fundamentals-based, first principles analytical approach	Requires a detailed knowledge of principles and applied procedures and methodologies in defined aspects of a professional discipline with a strong emphasis on the application of developed technology and the attainment of know-how, often within a multidisciplinary engineering environment	Can be resolved using limited theoretical knowledge but normally requires extensive practical knowledge
5	Familiarity of issues	Involve infrequently encountered issues	Belong to families of familiar problems which are solved in well-accepted ways	Are frequently encountered and thus familiar to most practitioners in the practice area
6	Extent of applicable codes	Are outside problems encompassed by standards and codes of practice for professional engineering	May be partially outside those encompassed by standards or codes of practice	Are encompassed by standards and/or documented codes of practice
7	Extent of stakeholder involvement and level of conflicting requirements	Involve diverse groups of stakeholders with widely varying needs	Involve several groups of stakeholders with differing and occasionally conflicting needs	Involve a limited range of stakeholders with differing needs
8	Consequences	Have significant consequences in a range of contexts	Have consequences which are important locally, but may extend more widely	Have consequences which are locally important and not far-reaching
9	Interdependence	Are high level problems including many component parts or sub-problems	Are parts of, or systems within complex engineering problems	Are discrete components of engineering systems

4.2 Range of Engineering Activities

	Attribute	Complex Activities	Broadly-defined Activities	Well-defined Activities
1	Preamble	Complex activities means (<i>engineering</i>) activities or projects that have some or all of the following characteristics:	Broadly defined activities means (<i>engineering</i>) activities or projects that have some or all of the following characteristics:	Well-defined activities means (<i>engineering</i>) activities or projects that have some or all of the following characteristics:
2	Range of resources	Involve the use of diverse resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)	Involve a variety of resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)	Involve a limited range of resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)
3	Level of interactions	Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues,	Require resolution of occasional interactions between technical, engineering and other issues, of which few are conflicting	Require resolution of interactions between limited technical and engineering issues with little or no impact of wider issues
4	Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.	Involve the use of new materials, techniques or processes in non-standard ways	Involve the use of existing materials techniques, or processes in modified or new ways
5	Consequences to society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation	Have reasonably predictable consequences that are most important locally, but may extend more widely	Have consequences that are locally important and not far-reaching
6	Familiarity	Can extend beyond previous experiences by applying principles-based approaches	Require a knowledge of normal operating procedures and processes	Require a knowledge of practical procedures and practices for widely-applied operations and processes

5 Accord programme profiles

The following tables provides profiles of graduates of three types of tertiary education engineering programmes. See section 4 for definitions of complex engineering problems, broadly-defined engineering problems and well-defined engineering problems.

5.1 Knowledge profile

A Washington Accord programme provides:	A Sydney Accord programme provides:	A Dublin Accord programme provides:
<ul style="list-style-type: none"> A systematic, theory-based understanding of the natural sciences applicable to the discipline (e.g. calculus-based physics) 	<ul style="list-style-type: none"> A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline 	<ul style="list-style-type: none"> A descriptive, formula-based understanding of the natural sciences applicable in a sub-discipline
<ul style="list-style-type: none"> Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline 	<ul style="list-style-type: none"> Conceptually-based mathematics, numerical analysis, statistics and aspects of computer and information science to support analysis and use of models applicable to the sub-discipline 	<ul style="list-style-type: none"> Procedural mathematics, numerical analysis, statistics applicable in a sub-discipline
<ul style="list-style-type: none"> A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline 	<ul style="list-style-type: none"> A systematic, theory-based formulation of engineering fundamentals required in an accepted sub-discipline 	<ul style="list-style-type: none"> A coherent procedural formulation of engineering fundamentals required in an accepted sub-discipline
<ul style="list-style-type: none"> engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline. 	<ul style="list-style-type: none"> engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline 	<ul style="list-style-type: none"> engineering specialist knowledge that provides the body of knowledge for an accepted sub-discipline
<ul style="list-style-type: none"> knowledge that supports engineering design in a practice area 	<ul style="list-style-type: none"> knowledge that supports engineering design using the technologies of a practice area 	<ul style="list-style-type: none"> knowledge that supports engineering design based on the techniques and procedures of a practice area
<ul style="list-style-type: none"> knowledge of engineering practice (technology) in the practice areas in the engineering discipline 	<ul style="list-style-type: none"> knowledge of engineering technologies applicable in the sub-discipline 	<ul style="list-style-type: none"> codified practical engineering knowledge in recognised practice area.
<ul style="list-style-type: none"> comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability; 	<ul style="list-style-type: none"> comprehension of the role of technology in society and identified issues in applying engineering technology: ethics and impacts: economic, social, environmental and sustainability 	<ul style="list-style-type: none"> knowledge of issues and approaches in engineering technician practice: ethics, financial, cultural, environmental and sustainability impacts
<ul style="list-style-type: none"> Engagement with selected knowledge in the research literature of the discipline 	<ul style="list-style-type: none"> engagement with the technological literature of the discipline 	
<p>A programme that builds this type of knowledge and develops the attributes listed below is typically achieved in 4 to 5 years of study, depending on the level of students at entry.</p>	<p>A programme that builds this type of knowledge and develops the attributes listed below is typically achieved in 3 to 4 years of study, depending on the level of students at entry.</p>	<p>A programme that builds this type of knowledge and develops the attributes listed below is typically achieved in 2 to 3 years of study, depending on the level of students at entry.</p>

5.2 Graduate Attribute profiles

		Differentiating Characteristic	... for Washington Accord Graduate	... for Sydney Accord Graduate	... for Dublin Accord Graduate
1.	Engineering Knowledge	Breadth and depth of education and type of knowledge, both theoretical and practical	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to defined and applied engineering procedures, processes, systems or methodologies.	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to wide practical procedures and practices.
2.	Problem Analysis	Complexity of analysis	Identify, formulate, research literature and analyse <i>complex</i> engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	Identify, formulate, research literature and analyse <i>broadly-defined</i> engineering problems reaching substantiated conclusions using analytical tools appropriate to their discipline or area of specialisation.	Identify and analyse <i>well-defined</i> engineering problems reaching substantiated conclusions using codified methods of analysis specific to their field of activity.
3.	Design/ development of solutions	Breadth and uniqueness of engineering problems i.e. the extent to which problems are original and to which solutions have previously been identified or codified	Design solutions for <i>complex</i> engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	Design solutions for <i>broadly- defined</i> engineering technology problems and <i>contribute</i> to the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	Design solutions for <i>well-defined</i> technical problems and <i>assist with</i> the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4.	Investigation	Breadth and depth of investigation and experimentation	Conduct investigations of <i>complex</i> problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	Conduct investigations of <i>broadly-defined</i> problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions.	Conduct investigations of <i>well-defined</i> problems; locate and search relevant codes and catalogues, conduct standard tests and measurements.
5.	Modern Tool Usage	Level of understanding of the appropriateness of the tool	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to <i>complex</i> engineering activities, with an understanding of the limitations.	Select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to <i>broadly-defined</i> engineering activities, with an understanding of the limitations.	Apply appropriate techniques, resources, and modern engineering and IT tools to <i>well-defined</i> engineering activities, with an awareness of the limitations.

6.	The Engineer and Society	Level of knowledge and responsibility	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.	Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering technology practice.	Demonstrate knowledge of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering technician practice.
7.	Environment and Sustainability	Type of solutions.	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.	Understand the impact of engineering technology solutions in societal and environmental context and demonstrate knowledge of and need for sustainable development.	Understand the impact of engineering technician solutions in societal and environmental context and demonstrate knowledge of and need for sustainable development.
8.	Ethics	Understanding and level of practice	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	Understand and commit to professional ethics and responsibilities and norms of engineering technology practice.	Understand and commit to professional ethics and responsibilities and norms of technician practice.
9.	Individual and Team work	Role in and diversity of team	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	Function effectively as an individual, and as a member or leader in diverse technical teams.	Function effectively as an individual, and as a member in diverse technical teams.
10.	Communication	Level of communication according to type of activities performed	Communicate effectively on <i>complex</i> engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	Communicate effectively on <i>broadly-defined</i> engineering activities with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	Communicate effectively on <i>well-defined</i> engineering activities with the engineering community and with society at large, by being able to comprehend the work of others, document their own work, and give and receive clear instructions
11.	Project Management and Finance	Level of management required for differing types of activity	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member and leader in a team and to manage projects in multidisciplinary environments	Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member and leader in a technical team and to manage projects in multidisciplinary environments
12.	Life long learning	Preparation for and depth of continuing learning.	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	Recognize the need for, and have the ability to engage in independent and life-long learning in specialist technologies.	Recognize the need for, and have the ability to engage in independent updating in the context of specialized technical knowledge.

6 Professional Competency Profiles

To meet the minimum standard of competence a person must demonstrate that he/she is able to practice competently in his/her practice area to the standard expected of a reasonable Professional Engineer/Engineering Technologist/Engineering Technician.

The extent to which the person is able to perform each of the following elements in his/her practice area must be taken into account in assessing whether or not he/she meets the overall standard.

		Differentiating Characteristic	Professional Engineer	Engineering Technologist	Engineering Technician
1.	Comprehend and apply universal knowledge	Breadth and depth of education and type of knowledge	Comprehend and apply advanced knowledge of the widely-applied principles underpinning good practice	Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems or methodologies	Comprehend and apply knowledge embodied in standardised practices
2.	Comprehend and apply local knowledge	Type of local knowledge	Comprehend and apply advanced knowledge of the widely-applied principles underpinning good practice specific to the jurisdiction in which he/she practices.	Comprehend and apply the knowledge embodied procedures, processes, systems or methodologies that is specific to the jurisdiction in which he/she practices.	Comprehend and apply knowledge embodied in standardised practices specific to the jurisdiction in which he/she practices.
3.	Problem analysis	Complexity of analysis	Define, investigate and analyse complex problems	Identify, clarify, and analyse broadly-defined problems	Identify, state and analyse well-defined problems
4.	Design and development of solutions	Nature of the problem and uniqueness of the solution	Design or develop solutions to complex problems	Design or develop solutions to broadly-defined problems	Design or develop solutions to well-defined problems
5.	Evaluation	Type of activity	Evaluate the outcomes and impacts of complex activities	Evaluate the outcomes and impacts of broadly defined activities	Evaluate the outcomes and impacts of well-defined activities
6.	Protection of society	Types of activity and responsibility to public	Recognise the reasonably foreseeable social, cultural and environmental effects of complex activities generally, and have regard to the need for sustainability; recognise that the protection of society is the highest priority	Recognise the reasonably foreseeable social, cultural and environmental effects of broadly-defined activities generally, and have regard to the need for sustainability; take responsibility in all these activities to avoid putting the public at risk.	Recognise the reasonably foreseeable social, cultural and environmental effects of well-defined activities generally, and have regard to the need for sustainability; use engineering technical expertise to prevent dangers to the public.
7.	Legal and regulatory	No differentiation in this characteristic	Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities	Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities	Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities

8.	Ethics	No differentiation in this characteristic	Conduct his or her activities ethically	Conduct his or her activities ethically	Conduct his or her activities ethically
9.	Manage engineering activities	Types of activity	Manage part or all of one or more complex activities	Manage part or all of one or more broadly-defined activities	Manage part or all of one or more well-defined activities
10.	Communication	No differentiation in this characteristic	Communicate clearly with others in the course of his or her activities	Communicate clearly with others in the course of his or her activities	Communicate clearly with others in the course of his or her activities
11.	Lifelong learning	Preparation for and depth of continuing learning.	Undertake CPD activities sufficient to maintain and extend his or her competence	Undertake CPD activities sufficient to maintain and extend his or her competence	Undertake CPD activities sufficient to maintain and extend his or her competence
12.	Judgement	Level of developed knowledge, and ability and judgement in relation to type of activity	Recognize complexity and assess alternatives in light of competing requirements and incomplete knowledge. Exercise sound judgement in the course of his or her complex activities	Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of his or her broadly-defined activities	Choose and apply appropriate technical expertise. Exercise sound judgement in the course of his or her well-defined activities
13.	Responsibility for decisions	Type of activity for which responsibility is taken	Be responsible for making decisions on part or all of complex activities	Be responsible for making decisions on part or all of one or more broadly defined activities	Be responsible for making decisions on part or all of all of one or more well-defined activities

Appendix A: Definitions of terms

Note: These definitions apply to terms used in this document but also indicate equivalence to terms used in other engineering education standards.

Branch of engineering: a generally-recognised, major subdivision of engineering such as the traditional *disciplines* of Chemical, Civil, or Electrical Engineering, or a cross-disciplinary field of comparable breadth including combinations of engineering fields, for example Mechatronics, and the application of engineering in other fields, for example Bio-Medical Engineering.

Broadly-defined engineering problems: a class of problem with characteristics defined in section 4.1.

Broadly-defined engineering activities: a class of activities with characteristics defined in section 4.2.

Complementary (contextual) knowledge: Disciplines other than engineering, basic and mathematical sciences, that support engineering practice, enable its impacts to be understood and broaden the outlook of the engineering graduate.

Complex engineering problems: a class of problem with characteristics defined in section 4.1.

Complex engineering activities: a class of activities with characteristics defined in section 4.2.

Continuing Professional Development: the systematic, accountable maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional and technical duties throughout an engineering practitioner's career.

Engineering sciences: include engineering fundamentals that have roots in the mathematical and physical sciences, and where applicable, in other natural sciences, but extend knowledge and develop models and methods in order to lead to applications and solve problems, providing the knowledge base for engineering specializations.

Engineering design knowledge: Knowledge that supports engineering design in a practice area, including codes, standards, processes, empirical information, and knowledge reused from past designs.

Engineering discipline: synonymous with *branch of engineering*.

Engineering fundamentals: a systematic formulation of engineering concepts and principles based on mathematical and basic sciences to support applications.

Engineering problem: is one that exists in any domain that can be solved by the application of engineering knowledge and skills and generic competencies.

Engineering practice: a generally accepted or legally defined area of engineering work or engineering technology.

Engineering speciality or specialization: a generally-recognised practice area or major subdivision within an engineering discipline, for example Structural and Geotechnical Engineering within Civil Engineering; the extension of engineering fundamentals to create theoretical frameworks and bodies of knowledge for engineering practice areas.

Engineering technology: is an established body of knowledge, with associated tools, techniques, materials, components, systems or processes that enable a family of practical applications and that relies for its development and effective application on engineering knowledge and competency.

Formative development: the process that follows the attainment of an accredited education programme that consists of training, experience and expansion of knowledge.

Manage: means planning, organising, leading and controlling in respect of risk, project, change, financial, compliance, quality, ongoing monitoring, control and evaluation.

Mathematical sciences: mathematics, numerical analysis, statistics and aspects of computer science cast in an appropriate mathematical formalism.

Natural sciences: Provide, as applicable in each engineering discipline or practice area, an understanding the physical world including physics, mechanics, chemistry, earth sciences and the biological sciences,

Practice area: *in the educational context:* synonymous with generally-recognised engineering speciality; *at the professional level:* a generally recognised or distinctive area of knowledge and expertise developed by an engineering practitioner by virtue of the path of education, training and experience followed.

Research-based knowledge: a systematic understanding of knowledge and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of the academic discipline, field of study or area of professional practice.

Solution: means an effective proposal for resolving a problem, taking into account all relevant technical, legal, social, cultural, economic and environmental issues and having regard to the need for sustainability.

Subdiscipline: Synonymous with *engineering speciality*.

Substantial equivalence: 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.

Well-defined engineering problems: a class of problem with characteristics defined in section 4.1.

Well-defined engineering activities: a class of activities with characteristics defined in section 4.2.

Appendix B: History of Graduate Attributes and Professional Competency Profiles

The signatories to the Washington Accord recognized the need to describe the attributes of a graduate of a Washington Accord accredited program. Work was initiated at its June 2001 meeting held at Thornybush, South Africa. At the International Engineering Meetings (IEM) held in June 2003 at Rotorua, New Zealand, the signatories to the Sydney Accord and the Dublin Accord recognized similar needs. The need was recognized to distinguish the attributes of graduates of each type of programme to ensure fitness for their respective purposes.

The Engineers Mobility Forum (EMF) and Engineering Technologist Mobility Forum (ETMF) have created international registers in each jurisdiction with current admission requirements based on registration, experience and responsibility carried. The mobility agreements recognize the future possibility of competency-based assessment for admission to an international register. At the 2003 Rotorua meetings, the mobility fora recognized that many jurisdictions are in the process of developing and adopting competency standards for professional registration. The EMF and the ETMF therefore resolved to define assessable sets of competencies for engineer and technologist. While no comparable mobility agreement exists for technicians, the development of a corresponding set of standards for engineering technicians was felt to be important to have a complete description of the competencies of the engineering team.

A single process was therefore agreed to develop the three sets of graduate attributes and three professional competency profiles. An International Engineering Workshop (IEWS) was held by the three educational accord and the two mobility fora in London in June 2004 to develop statements of Graduate Attributes and International Register Professional Competency Profiles for the Engineer, Engineering Technologist and Engineering Technician categories. The resulting statements were then opened for comment by the signatories. The comments received called for minor changes only.

The Graduate Attributes and Professional Competencies were adopted by the signatories of the five agreements in June 2005 at Hong Kong as version 1.1.

A number of areas of improvement in the Graduate Attributes and Professional Competencies themselves and their potential application were put to the meetings of signatories in Washington DC in June 2007. A working group was set up to address the issues. The IEA workshop held in June 2008 in Singapore considered the proposals of the working group and commissioned the Working Group to make necessary changes with a view to presenting Version 2 of the document for approval by the signatories at their next general meetings. Version 2 was approved at the Kyoto IEA meetings, 15-19 June 2009.

This document is available through the IEA website: <http://www.ieagrements.org>.