

Graduate Attributes and Professional Competencies

Version 3: 21 June 2013

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

Executive Summary

Several accrediting bodies for engineering qualifications have developed outcomesbased criteria for evaluating programmes. Similarly, a number of engineering regulatory bodies have developed or are in the process of developing competencybased 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 jurisdictions. 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 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 International Professional Engineers Agreement (IPEA) and the International Engineering Technologists Agreement (IETA) 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 competence 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 Graduate Attributes and the Quality of Programmes

The Washington, Sydney and Dublin Accords “recognise the substantial equivalence of ... programmes satisfying the academic requirements for practice ...” for engineers, engineering technologists and engineering technicians respectively. The Graduate Attributes are assessable outcomes, supported by level statements, developed by the signatories that give confidence that the educational objectives of programmes are being achieved. The quality of a programme depends not only on the stated objectives and attributes to be assessed but also on the programme design, resources committed to the programme, the teaching and learning process and assessment of students, including confirmation that the graduate attributes are satisfied. The Accords therefore base the judgement of the substantial equivalence of programmes accredited by signatories on both the Graduate Attributes and the best practice indicators for evaluating programme quality listed in the Accords’ Rules and Procedures.

2.4 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 defined in sections 4.1 and 5.1. For example, for the **Knowledge of Engineering Sciences** attribute:

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

Engineer Range: ... as described in the engineer knowledge profile to the solution of complex engineering problems.

Engineering Technologist Range: ... as described in the engineering technologist knowledge profile to defined and applied engineering procedures, processes, systems or methodologies.

Engineering Technician Range: ... as described in the engineering technician knowledge profile 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 as specified in WK1-WK4 respectively to the solution of complex engineering problems.	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization as specified in SK1-SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.	Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization as specified in DK1-DK4 respectively 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 4.1.

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 is given in section 5.

2.5 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.

2.6 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 registration. 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.

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

References to the Knowledge Profile are shown thus: (WK3, WK4 ...)

In the context of both Graduate Attributes and Professional Competencies:			
Attribute	Complex Engineering Problems have characteristic WP1 and some or all of WP2 to WP7:	Broadly-defined Engineering Problems have characteristic SP1 and some or all of SP2 to SP7:	Well-defined Engineering Problems have characteristic DP1 and some or all of DP2 to DP7:
<u>Depth of Knowledge Required</u>	WP1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamentals-based, first principles analytical approach	SP1: Cannot be resolved without engineering knowledge at the level of one or more of SK 4, SK5, and SK6 supported by SK3 with a strong emphasis on the application of developed technology	DP1: Cannot be resolved without extensive practical knowledge as reflected in DK5 and DK6 supported by theoretical knowledge defined in DK3 and DK4
Range of conflicting requirements	WP2: Involve wide-ranging or conflicting technical, engineering and other issues	SP2: Involve a variety of factors which may impose conflicting constraints	DP2: Involve several issues, but with few of these exerting conflicting constraints
Depth of analysis required	WP3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models	SP3: Can be solved by application of well-proven analysis techniques	DP3: Can be solved in standardised ways
Familiarity of issues	WP4: Involve infrequently encountered issues	SP4: Belong to families of familiar problems which are solved in well-accepted ways	DP4: Are frequently encountered and thus familiar to most practitioners in the practice area
Extent of applicable codes	WP5: Are outside problems encompassed by standards and codes of practice for professional engineering	SP5: May be partially outside those encompassed by standards or codes of practice	DP5: Are encompassed by standards and/or documented codes of practice

Extent of stakeholder involvement and conflicting requirements	WP6: Involve diverse groups of stakeholders with widely varying needs	SP6: Involve several groups of stakeholders with differing and occasionally conflicting needs	DP6: Involve a limited range of stakeholders with differing needs
Interdependence	WP 7: Are high level problems including many component parts or sub-problems	SP7: Are parts of, or systems within complex engineering problems	DP7: Are discrete components of engineering systems
<i>In addition, in the context of the Professional Competencies</i>			
Consequences	EP1: Have significant consequences in a range of contexts	TP1: Have consequences which are important locally, but may extend more widely	NP1: Have consequences which are locally important and not far-reaching
Judgement	EP2: Require judgement in decision making	TP2: Require judgement in decision making	

4.2 Range of Engineering Activities

Attribute	Complex Activities	Broadly-defined Activities	Well-defined Activities
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:
Range of resources	EA1: Involve the use of diverse resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)	TA1: Involve a variety of resources (and for this purposes resources includes people, money, equipment, materials, information and technologies)	NA1: Involve a limited range of resources (and for this purpose resources includes people, money, equipment, materials, information and technologies)
Level of interactions	EA2: Require resolution of significant problems arising from interactions between wideranging or conflicting technical, engineering or other issues,	TA2: Require resolution of occasional interactions between technical, engineering and other issues, of which few are conflicting	NA2: Require resolution of interactions between limited technical and engineering issues with little or no impact of wider issues

Innovation	EA3: Involve creative use of engineering principles and research-based knowledge in novel ways.	TA3: Involve the use of new materials, techniques or processes in non-standard ways	NA3: Involve the use of existing materials techniques, or processes in modified or new ways
Consequences to society and the environment	EA4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation	TA4: Have reasonably predictable consequences that are most important locally, but may extend more widely	NA4: Have consequences that are locally important and not far-reaching
Familiarity	EA5: Can extend beyond previous experiences by applying principles-based approaches	TA5: Require a knowledge of normal operating procedures and processes	NA5: 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:
WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline	SK1: A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline	DK1: A descriptive, formula-based understanding of the natural sciences applicable in a sub-discipline
WK2: Conceptually-based mathematics , numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline	SK2: 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	DK2: Procedural mathematics , numerical analysis, statistics applicable in a sub-discipline
WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline	SK3: A systematic , theory-based formulation of engineering fundamentals required in an accepted sub-discipline	DK3: A coherent procedural formulation of engineering fundamentals required in an accepted sub-discipline

WK4: 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.	SK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline	DK4: Engineering specialist knowledge that provides the body of knowledge for an accepted sub-discipline
WK5: Knowledge that supports engineering design in a practice area	SK5: Knowledge that supports engineering design using the technologies of a practice area	DK5: Knowledge that supports engineering design based on the techniques and procedures of a practice area
WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline	SK6: Knowledge of engineering technologies applicable in the sub-discipline	DK6: Codified practical engineering knowledge in recognised practice area.
WK7: 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	SK7: Comprehension of the role of technology in society and identified issues in applying engineering technology: ethics and impacts: economic, social, environmental and sustainability	DK7: Knowledge of issues and approaches in engineering technician practice: ethics, financial, cultural, environmental and sustainability impacts
WK8: Engagement with selected knowledge in the research literature of the discipline	SK8: Engagement with the technological literature of the discipline	
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.	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.	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.

5.2 Graduate Attribute Profiles

References to the Knowledge Profile are shown thus: (WK1 to WK4)

Differentiating Characteristic	... for Washington Accord Graduate	... for Sydney Accord Graduate	... for Dublin Accord Graduate
--------------------------------	------------------------------------	--------------------------------	--------------------------------

<p>Engineering Knowledge:</p>	<p>WA1: Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to the solution of complex engineering problems.</p>	<p>SA1: Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in SK1 to SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.</p>	<p>DA1: Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in DK1 to DK4 respectively to wide practical procedures and practices.</p>
<p>Problem Analysis Complexity of analysis</p>	<p>WA2: Identify, formulate, research literature and analyse <i>complex</i> engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (WK1 to WK4)</p>	<p>SA2: Identify, formulate, research literature and analyse <i>broadly-defined</i> engineering problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialisation. (SK1 to SK4)</p>	<p>DA2: Identify and analyse <i>well-defined</i> engineering problems reaching substantiated conclusions using codified methods of analysis specific to their field of activity. (DK1 to DK4)</p>
<p>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</p>	<p>WA3: 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. (WK5)</p>	<p>SA3: Design solutions for <i>broadly- defined</i> engineering technology problems and <i>contribute to</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. (SK5)</p>	<p>DA3: 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. (DK5)</p>

<p>Investigation: Breadth and depth of investigation and experimentation</p>	<p>WA4: Conduct investigations of <i>complex</i> problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.</p>	<p>SA4: Conduct investigations of <i>broadly-defined</i> problems; locate, search and select relevant data from codes, data bases and literature (SK8), design and conduct experiments to provide valid conclusions.</p>	<p>DA4: Conduct investigations of <i>well-defined</i> problems; locate and search relevant codes and catalogues, conduct standard tests and measurements.</p>
<p>Modern Tool Usage: Level of understanding of the appropriateness of the tool</p>	<p>WA5: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to <i>complex</i> engineering problems, with an understanding of the limitations. (WK6)</p>	<p>SA5: Select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to <i>broadly-defined</i> engineering problems, with an understanding of the limitations. (SK6)</p>	<p>DA5: Apply appropriate techniques, resources, and modern engineering and IT tools to <i>welldefined</i> engineering problems, with an awareness of the limitations. (DK6)</p>

<p>The Engineer and Society: Level of knowledge and responsibility</p>	<p>WA6: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (WK7)</p>	<p>SA6: Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering technology practice and solutions to broadly defined engineering problems. (SK7)</p>	<p>DA6: Demonstrate knowledge of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering technician practice and solutions to well defined engineering problems. (DK7)</p>
<p>Environment and Sustainability: Type of solutions.</p>	<p>WA7: Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (WK7)</p>	<p>SA7: Understand and evaluate the sustainability and impact of engineering technology work in the solution of broadly defined engineering problems in societal and environmental contexts. (SK7)</p>	<p>DA7: Understand and evaluate the sustainability and impact of engineering technician work in the solution of well defined engineering problems in societal and environmental contexts. (DK7)</p>
<p>Ethics: Understanding and level of practice</p>	<p>WA8: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (WK7)</p>	<p>SA8: Understand and commit to professional ethics and responsibilities and norms of engineering technology practice. (SK7)</p>	<p>DA8: Understand and commit to professional ethics and responsibilities and norms of technician practice. (DK7)</p>
<p>Individual and Team work: Role in and diversity of team</p>	<p>WA9: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.</p>	<p>SA9: Function effectively as an individual, and as a member or leader in diverse teams.</p>	<p>DA9: Function effectively as an individual, and as a member in diverse technical teams.</p>

<p>Communication: Level of communication according to type of activities performed</p>	<p>WA10: 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.</p>	<p>SA10: Communicate effectively on <i>broadlydefined</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</p>	<p>DA10: 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</p>
<p>Project Management and Finance: Level of management required for differing types of activity</p>	<p>WA11: Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.</p>	<p>SA11: Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.</p>	<p>DA11: Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a technical team and to manage projects in multidisciplinary environments</p>
<p>Lifelong learning: Preparation for and depth of continuing learning.</p>	<p>WA12: 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.</p>	<p>SA12: Recognize the need for, and have the ability to engage in independent and life-long learning in specialist technologies.</p>	<p>DA12: Recognize the need for, and have the ability to engage in independent updating in the context of specialized technical knowledge.</p>

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
<p>Comprehend and apply universal knowledge: Breadth and depth of education and type of knowledge</p>	<p>EC1: Comprehend and apply advanced knowledge of the widely-applied principles underpinning good practice</p>	<p>TC1: Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems or methodologies</p>	<p>NC1: Comprehend and apply knowledge embodied in standardised practices</p>
<p>Comprehend and apply local knowledge: Type of local knowledge</p>	<p>EC2: Comprehend and apply advanced knowledge of the widely-applied principles underpinning good practice specific to the jurisdiction in which he/she practices.</p>	<p>TC2: Comprehend and apply the knowledge embodied procedures, processes, systems or methodologies that is specific to the jurisdiction in which he/she practices.</p>	<p>NC2: Comprehend and apply knowledge embodied in standardised practices specific to the jurisdiction in which he/she practices.</p>
<p>Problem analysis: Complexity of analysis</p>	<p>EC3: Define, investigate and analyse complex problems</p>	<p>TC3: Identify, clarify, and analyse broadlydefined problems</p>	<p>NC3: Identify, state and analyse well-defined problems</p>
<p>Design and development of solutions: Nature of the problem and uniqueness of the solution</p>	<p>EC4: Design or develop solutions to complex problems</p>	<p>TC4: Design or develop solutions to broadlydefined problems</p>	<p>NC4: Design or develop solutions to welldefined problems</p>
<p>Evaluation: Type of activity</p>	<p>EC5: Evaluate the outcomes and impacts of complex activities</p>	<p>TC4: Evaluate the outcomes and impacts of broadly defined activities</p>	<p>NC5: Evaluate the outcomes and impacts of well-defined activities</p>

<p>Protection of society: Types of activity and responsibility to public</p>	<p>EC6: 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</p>	<p>TC6: 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.</p>	<p>NC6: 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.</p>
---	--	--	--

<p>Legal and regulatory: No differentiation in this characteristic</p>	<p>EC7: Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities</p>	<p>TC7: Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities</p>	<p>NC7: Meet all legal and regulatory requirements and protect public health and safety in the course of his or her activities</p>
<p>Ethics: No differentiation in this characteristic</p>	<p>EC8: Conduct his or her activities ethically</p>	<p>TC8: Conduct his or her activities ethically</p>	<p>NC8: Conduct his or her activities ethically</p>
<p>Manage engineering activities: Types of activity</p>	<p>EC9: Manage part or all of one or more complex activities</p>	<p>TC9: Manage part or all of one or more broadly-defined activities</p>	<p>NC9: Manage part or all of one or more welldefined activities</p>
<p>Communication: No differentiation in this characteristic</p>	<p>EC10: Communicate clearly with others in the course of his or her activities</p>	<p>TC10: Communicate clearly with others in the course of his or her activities</p>	<p>NC10: Communicate clearly with others in the course of his or her activities</p>
<p>Lifelong learning: Preparation for and depth of continuing learning.</p>	<p>EC11: Undertake CPD activities sufficient to maintain and extend his or her competence</p>	<p>TC11: Undertake CPD activities sufficient to maintain and extend his or her competence</p>	<p>NC11: Undertake CPD activities sufficient to maintain and extend his or her competence</p>

<p>Judgement: Level of developed knowledge, and ability and judgement in relation to type of activity</p>	<p>EC11: 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</p>	<p>TC12: Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of his or her broadly-defined activities</p>	<p>NC12: Choose and apply appropriate technical expertise. Exercise sound judgement in the course of his or her welldefined activities</p>
<p>Responsibility for decisions: Type of activity for which responsibility is taken</p>	<p>EC12: Be responsible for making decisions on part or all of complex activities</p>	<p>TC13: Be responsible for making decisions on part or all of one or more broadly defined activities</p>	<p>NC13: Be responsible for making decisions on part or all of all of one or more welldefined activities</p>

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 natural sciences to support applications.

Engineering management: the generic management functions of planning, organising, leading and controlling, applied together with engineering knowledge in contexts including the management of projects, construction, operations, maintenance, quality, risk, change and business.

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

Engineering practice area: 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.

Forefront of the professional discipline/branch: defined by advanced practice in the specialisations within the discipline.

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.

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 or more 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 Thornybusch, 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.

Version 1

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.

Version 2

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.

Version 3

Between 2009 and 2012 a number of possible improvements to the graduate attributes were recorded. During 2012 signatories performed an analysis of gaps between their respective standards and the Graduate Attribute exemplars and by June 2013 most signatories reported substantial equivalence of their standards to the Graduate Attributes. This will be further examined in periodic monitoring reviews in 2014 to 2019. In this process a number of improvements to the wording of the Graduate Attributes and supporting definitions were identified. The signatories to the Washington, Sydney and Dublin Accords approved the changes resulting in this Version 3 at their meetings in Seoul 17-21 June 2013. Signatories stated that the objectives of the changes were to clarify aspects of the Graduate Attribute exemplar. There was no intent to raise the standard. The main changes were as follows:

- New Section 2.3 inserted;
- Range of problem solving in section 4.1 linked to the Knowledge Profiles in section 5.1 and duplication removed;
- Graduate Attributes in section 5.2: cross-references to Knowledge Profile elements inserted; improved wording in attributes 6, 7 and 11;
- Appendix A: definitions of *engineering management* and *forefront of discipline* added.