Constituent Agreements

Washington Accord	International Professional Engineers Agreement
Sydney Accord	International Engineering Technologists Agreement
Dublin Accord	APEC Engineer Agreement

Graduate Attributes and Professional Competences

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Executive Summary

Many accrediting bodies for engineering qualifications have developed outcomes-based criteria for evaluating programs. Similarly, ~~a number~~ many ~~of~~ engineering regulatory bodies have developed or are in the process of developing competence-based standards for registration. Educational and professional accords for mutual recognition of qualifications and registration have developed statements of graduate attributes and professional competence profiles. This document, which is a revised version that takes into account the present-day state of engineering activities, presents the background to these developments, their purpose and the methodology and limitations of the statements. After defining general range statements that allow the competences of the different categories to be distinguished, the paper presents the graduate attributes and professional competence 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. *The United Nations Sustainable Development Goals present targets for 2030. Engineers are vital contributors for making progress towards these goals.*

Typical engineering activity requires several roles including those of the engineer, engineering technologist and engineering technician, recognized as professional registration categories in many jurisdictions[1]. These roles are defined by their distinctive competences and their level of responsibility to the public. There is a degree of overlap between roles. The distinctive competences, together with their educational underpinnings, are defined in sections 4 to 6 of this document.

[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.

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 competences 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 competences 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, engineering technologists, and engineering technicians, 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 competence throughout their working lives.

Several international accords provide for recognition of graduates of accredited programs of each signatory by the remaining signatories. The Washington Accord (WA) provides for mutual recognition of programs 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[2] (IPEA), ~~and~~ the International Engineering Technologists Agreement[3] (IETA), and the Agreement for International Engineering Technicians (AIET) provide mechanisms to support the recognition of a professional registered in one signatory jurisdiction obtaining recognition in another. The signatories have formulated consensus competence profiles for the registration and these are recorded in this document.

Section 2 give the background to the graduate attributes presented in section 5. Section 3 provides background to the professional competence profiles presented in section 6. General range statements are presented in section 4. The graduate attributes are presented in section 5 while the professional competence 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 competence 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 program. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary by a range indication appropriate to the type of program.

The graduate attributes are intended to assist Signatories and Provisional Members to develop or review their outcomes-based accreditation criteria for use by their respective jurisdictions. Also, the graduate attributes guide bodies in developing or revising 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 different types of programs.

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 programs are accredited. Each educational level accord is based on the principle of *substantial equivalence*, that is, programs are not expected to have identical outcomes and content but rather produce graduates who could enter employment and be fit to undertake a program 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 or benchmark for bodies to describe the outcomes of substantially equivalent qualifications.

Graduate Attributes may be accepted for use within a jurisdiction or adapted to accommodate the context and any specific requirements of the jurisdiction. Where a signatory has adapted or developed their own graduate attributes, it is expected that there is alignment to these graduate attributes.

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 Programs

The Washington, Sydney and Dublin Accords "recognize the substantial equivalence of … programs 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 programs are being achieved. The quality of a program depends not only on the stated objectives and attributes to be assessed but also on the program design, resources committed to the program, 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 programs accredited by signatories on both the Graduate Attributes and the best practice indicators for evaluating program quality listed in the Accords' Rules and Procedures[2].

2.4 Scope and Organization of Graduate Attributes

The graduate attributes are organized using eleven 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, natural science, computing and engineering fundamentals, and an engineering specialization …
>
> > **Engineer Range:** … as specified in the engineer knowledge profile to ~~the~~ develop solutions to ~~of~~ complex engineering problems.
> > **Engineering Technologist Range:** … as specified in the engineering technologist knowledge profile to defined and applied engineering procedures, processes, systems or methodologies.
> > **Engineering Technician Range:** … as specified in the engineering technician knowledge profile to wide practical procedures and practices.

The resulting statements are shown below for this example:

[2] Accord Rules and Procedures. June 2018, section C.4.5. Available at www.ieagreements.org.

Professional Engineer Graduate	Engineering Technologist Graduate	Engineering Technician Graduate
Apply knowledge of mathematics, science, computing and engineering fundamentals and an engineering specialization as specified in WK1-WK4 respectively to develop solutions ~~of~~ to complex engineering problems.	Apply knowledge of mathematics, science, computing and 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 they must not be altered in substance or individual elements ignored.

2.6 Best Practice in Application of Graduate Attributes

The attributes of Accord programs are defined as a *knowledge profile*, which is 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 programs that would achieve the requirements. Providers therefore have freedom to design programs with different detailed structure, learning pathways and modes of delivery. Evaluation of individual programs is the concern of national accreditation systems.

3 Professional Competence Profiles

3.1 Purpose of Professional Competence 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 competence profiles* for each professional category record the elements of competence necessary for 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 Organization of Professional Competence Profiles

The professional competence profiles are written for each of the three categories: engineer, engineering technologist and engineering technician at the point of registration[3]. 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 Competence Profile

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

The professional competence 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 competence 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 however 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 with 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 competence profiles are stated generically and are applicable to all engineering disciplines. The application of a competence 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.

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[3] Requirements for the IEPA, ~~and~~ IETA, and AIET International Registers call for enhanced competence and responsibility.

3.5 Mobility between Professional Categories

The graduate attributes and professional competence 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 requires additional education, training and experience. The graduate attributes and professional competences, through their definitions of level of demand, knowledge profile and outcomes to be achieved, allow a person planning such an attainment to judge 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 Identification and Solving

References included are to the Knowledge and Attitude Profile in 5.1

In the context of both Graduate Attributes and Professional Competences:			
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*:*
Depth of Knowledge Required	**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 engineering knowledge as reflected in DK5 and DK6 supported by theoretical knowledge defined in DK3 and DK4
Range of conflicting requirements	**WP2:** Involve wide-ranging and/or conflicting technical, non-technical issues (such as ethical, sustainability, legal, political, economic, societal) and consideration of future requirements	**SP2:** Involve a variety of conflicting technical and non-technical issues (such as ethical, sustainability, legal, political, economic, societal) and consideration of future requirements	**DP2:** Involve several technical and non-technical issues (such as ethical, sustainability, legal, political, economic, societal) and consideration of future requirements
Depth of analysis required	**WP3:** Have no obvious solution and require abstract thinking, creativity and originality in analysis to formulate suitable models	**SP3:** Can be solved by application of well-proven analysis techniques and models	**DP3:** Can be solved in standardized ways
Familiarity of issues	**WP4:** Involve infrequently encountered issues or novel problems	**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:** Address problems not encompassed by standards and codes of practice for professional engineering	**SP5:** Address problems that may ~~May~~ be partially outside those encompassed by standards or codes of practice	**DP5:** Addresses problems that are ~~Are~~ encompassed by standards and/or documented codes of practice
Extent of stakeholder involvement and conflicting requirements	**WP6:** Involve collaboration across engineering disciplines, ~~and~~ other fields, and/or diverse groups of stakeholders with widely varying needs	**SP6:** Involve different engineering disciplines and other fields with several groups of stakeholders with differing and occasionally conflicting needs	**DP6:** Involve a limited range of stakeholders with differing needs
Interdependence	**WP 7:** Address ~~Are~~ high level problems ~~including~~ with many components or sub-problems that may require a systems approach	**SP7:** Address components of~~, or~~ systems within complex engineering problems	**DP7:** Address ~~Are~~ discrete components of engineering systems

4.2 Range of Engineering Activities

Attribute	Complex Activities	Broadly-defined Activities	Well-defined Activities
Preamble	**Complex activities** means (*engineering)* activities or projects that have some or all of the following characteristics:	**Broadly defined activities** means (*engineering)* activities or projects that have some or all of the following characteristics:	**Well-defined activities** means *(engineering)* activities or projects that have some or all of the following characteristics:
Range of resources	**EA1:** Involve the use of diverse resources including people, data and information, natural, financial and physical resources and appropriate technologies including analytical and/or design software	**TA1:** Involve a variety of resources including people, data and information, natural, financial and physical resources and appropriate technologies including analytical and/or design software	**NA1:** Involve a limited range of resources for example people, data and information, natural, financial and physical resources and/or appropriate technologies
Level of interactions	**EA2:** Require optimal resolution of interactions between wide-ranging and/or conflicting technical, non-technical, and engineering ~~or other~~ issues	**TA2:** Require the best possible resolution of occasional interactions between technical, non-technical, and engineering issues, of which few are conflicting	**NA2:** Require the best possible resolution of interactions between limited technical, non-technical, and engineering issues
Innovation	**EA3:** Involve creative use of engineering principles, innovative solutions for a conscious purpose, and research-based knowledge	**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 predictable consequences with relatively limited and localised impact.'
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 program profiles

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

5.1 Knowledge and Attitude Profile

A Washington Accord program provides:	**A Sydney Accord program** provides:	**A Dublin Accord program** provides:
WK1: A systematic, theory-based understanding of the **natural sciences** applicable to the discipline and awareness of relevant **social sciences**	**SK1:** A systematic, theory-based understanding of the **natural sciences** applicable to the sub-discipline and awareness of relevant **social sciences**	**DK1:** A descriptive, formula-based understanding of the **natural sciences** applicable in a sub-discipline and awareness of directly relevant **social sciences**
WK2: Conceptually-based **mathematics**, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline	**SK2:** Conceptually-based **mathematics**, numerical analysis, , data analysis, statistics and formal aspects of computer and information science to support detailed consideration 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, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports **engineering design and operations** in a practice area	**SK5: :** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports **engineering design and operations** using the technologies of a practice area	**DK5:** Knowledge that supports **engineering design and operations** 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 recognized practice area.
WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, ~~ethics and~~ such as the professional responsibility of an engineer to public safety and sustainable development*	**SK7Knowledge of** the role of technology in society and identified issues in applying engineering technology, such as public safety and sustainable development*	**DK7: Knowledge** of issues and approaches in engineering technician practice, such as public safety and sustainable development*

A Washington Accord program provides:	**A Sydney Accord program** provides:	**A Dublin Accord program** provides:
WK8: Engagement with selected knowledge in the current **research literature** of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues	**SK8** Engagement with the current **technological literature** of the discipline and awareness of the power of critical thinking	**DK8:** Engagement with the current **technological literature** of the practice area
WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes	**SK9: Ethics, inclusive behavior and conduct.** Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes	**DK9: Ethical attitude, inclusive behavior and conduct.** Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes
*Represented by the 17 UN Sustainable Development Goals (UN-SDG)		
A program that builds this type of knowledge and attitude and develops the base attributes listed below is typically achieved in 4 to 5 years of study, depending on the level of students at entry.	A program that builds this type of knowledge and attitude and develops the base attributes listed below is typically achieved in 3 to 4 years of study, depending on the level of students at entry.	A program that builds this type of knowledge and attitude and develops the base 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 included are to the Knowledge and Attitude Profile in 5.1.

Differentiating Characteristic	**Professional Engineer Graduate**	**Engineering Technologist Graduate**	**Engineering Technician Graduate**
Engineering Knowledge: Breadth, depth and type of knowledge, both theoretical and practical	**WA1:** Apply knowledge of mathematics, natural science, computing and engineering fundamentals, and an engineering specialization as specified in WK1 to WK4 respectively to develop ~~the~~ solutions to ~~of~~ complex engineering problems	**SA1:** Apply knowledge of mathematics, natural science, computing and engineering fundamentals and an engineering specialization as specified in SK1 to SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.	**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.
Problem Analysis Complexity of analysis	**WA2:** Identify, formulate, research literature and analyze *complex* engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences with holistic considerations for sustainable development* (WK1 to WK4)	**SA2:** Identify, formulate, research literature and analyze *broadly-defined* engineering problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialisation. (SK1 to SK4)	**DA2:** Identify and analyze *well-defined* engineering problems reaching substantiated conclusions using codified methods of analysis specific to their field of activity. (DK1 to DK4)

Differentiating Characteristic	Professional Engineer Graduate	Engineering Technologist Graduate	Engineering Technician Graduate
Design/development of solutions: Breadth and uniqueness of engineering problems i.e., the extent to which problems are original and to which solutions have not previously been identified or codified	**WA3:** Design creative solutions for *complex* engineering problems and design systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required (WK5)	**SA3:** Design solutions for *broadly- defined* engineering technology problems and *contribute to* the design of systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required (SK5)	**DA3:** Design solutions for *well-defined* technical problems and *assist with* the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety as well as cultural, societal, and environmental considerations as required (DK5)
Investigation: Breadth and depth of investigation and experimentation	**WA4:** Conduct investigations of *complex* engineering problems using research methods including research-based knowledge, design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions (WK8)	**SA4:** Conduct investigations of *broadly-defined* engineering problems; locate, search and select relevant data from codes, data bases and literature design and conduct experiments to provide valid conclusions (SK8)	**DA4:** Conduct investigations of *well-defined* problems; locate and search relevant codes and catalogues, conduct standard tests and measurements (DK8)
Tool Usage: Level of understanding of the appropriateness of technologies and ~~the~~ tools	**WA5:** Create, select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to *complex* engineering problems (WK2 and WK6)	**SA5:** Select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to *broadly-defined* engineering problems (SK2 and SK6)	**DA5:** Apply appropriate techniques, resources, and modern computing, engineering, and IT tools to *well-defined* engineering problems, with an awareness of the limitations. (DK2 and DK6)
The Engineer and the World: Level of knowledge and responsibility for sustainable development	**WA6:** When solving complex engineering problems, analyze and evaluate sustainable development impacts* to: society, the economy, sustainability, health and safety, legal frameworks, and the environment (WK1, WK5, and WK7)	**SA6:** When solving broadly-defined engineering problems, analyze and evaluate sustainable development impacts* to: society, the economy, sustainability, health and safety, legal frameworks, and the environment (SK1, SK5, and SK7)	**DA6:** When solving well-defined engineering problems, evaluate sustainable development impacts* to: society, the economy, sustainability, health and safety, legal frameworks, and the environment~~-~~(DK1, DK5, and DK7)
Ethics: Understanding and level of practice	**WA7:** Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK9~~7~~)	**SA7:** Understand and commit to professional ethics and norms of engineering technology practice including compliance with national and international laws. Demonstrate an understanding of the need for diversity and inclusion (SK9~~7~~)	**DA7:** Understand and commit to professional ethics and norms of technician practice including compliance with relevant laws. Demonstrate an understanding of the need for diversity and inclusion (DK9~~7~~)

Differentiating Characteristic	Professional Engineer Graduate	Engineering Technologist Graduate	Engineering Technician Graduate
Individual and Collaborative Team work: Role in and diversity of team	**WA8:** Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (WK9)	**SA8:** Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (SK9)	**DA8:** Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (DK9)
Communication: Level of communication according to type of activities performed	**WA9:** Communicate effectively and inclusively on *complex* 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, taking into account cultural, language, and learning differences.	**SA9:** Communicate effectively and inclusively on *complex* 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, taking into account cultural, language, and learning differences.	**DA9:** Communicate effectively and inclusively on *well-defined* 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
Project Management and Finance: Level of management required for differing types of activity	**WA10:** Apply 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, and to manage projects and in multidisciplinary environments.	**SA10:** Apply 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.	**DA10:** Demonstrate awareness of engineering management principles as a member or leader in a technical team and to manage projects in multidisciplinary environments
Lifelong learning: ~~Preparation for and depth of continuing learning.~~ Duration and manner	**WA11:** Recognize the need for, and have the preparation and ability ~~to engage in~~ for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK8)	**SA11:** Recognize the need for, and have the ability to ~~engage in~~ for i) independent and life-long learning and ii) critical thinking in the face of new ~~in~~ specialist technologies (SK8)	**DA11:** Recognize the need for, and have the ability ~~to engage in~~ for independent updating in the face of ~~context of~~ specialized technical knowledge (DK8)
*Represented by the 17 UN Sustainable Development Goals (UN-SDG)			

6 Professional Competence Profiles

To meet the minimum standard of competence a person must demonstrate that they are able to practice competently in ~~his/her~~ a 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 the individual meets the overall standard.

Differentiating Characteristic	Professional Engineer	Engineering Technologist	Engineering Technician
Comprehend and apply universal knowledge: Breadth and depth of education and type of knowledge	**EC1:** Comprehend and apply advanced knowledge of the widely-applied principles underpinning good practice	**TC1:** Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems or methodologies	**NC1:** Comprehend and apply knowledge embodied in standardized practices
Comprehend and apply local knowledge: Type of local knowledge	**EC2:** Comprehend and apply advanced knowledge of the widely-applied principles underpinning good practice specific to the jurisdiction of practice	**TC2:** Comprehend and apply the knowledge embodied procedures, processes, systems or methodologies that is specific to the jurisdiction of practice	**NC2:** Comprehend and apply knowledge embodied in standardized practices specific to the jurisdiction of practice
Problem analysis: Complexity of analysis	**EC3:** Define, investigate and analyze complex problems using data and information technologies where applicable	**TC3:** Identify, clarify, and analyze broadly-defined problems using the support of computing and information technologies where applicable	**NC3:** Identify, state and analyze well-defined problems using the support of computing and information technologies where applicable
Design and development of solutions: Nature of the problem and uniqueness of the solution	**EC4:** Design or develop solutions to complex problems considering a variety of perspectives and taking account of stakeholder views	**TC4:** Design or develop solutions to broadly-defined problems considering a variety of perspectives.	**NC4:** Design or develop solutions to well-defined problems
Evaluation: Type of activity	**EC5:** Evaluate the outcomes and impacts of complex activities	**TC4:** Evaluate the outcomes and impacts of broadly defined activities	**NC5:** Evaluate the outcomes and impacts of well-defined activities
Protection of society: Types of activity and responsibility to consider sustainable outcomes ~~public~~	**EC6:** Recognize the ~~reasonably~~ foreseeable economic, social, ~~cultural~~ and environmental effects of complex activities and seek to achieve sustainable outcomes*	**TC6:** Recognize the ~~reasonably~~ foreseeable economic, social, ~~cultural~~ and environmental effects of broadly-defined activities and seek to achieve sustainable outcomes*	**NC6:** Recognize the ~~reasonably~~ foreseeable economic, social, ~~cultural~~ and environmental effects of well-defined activities and seek to achieve sustainable outcomes*.

Legal, regulatory, and cultural: No differentiation in this characteristic	**EC7:** Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of ~~his or her~~ all activities	**TC7:** Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of ~~his or her~~ all activities	**NC7:** Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of ~~his or her~~ all activities
Ethics: No differentiation in this characteristic	**EC8:** Conduct ~~his or her~~ activities ethically	**TC8:** Conduct ~~his or he~~r activities ethically	**NC8:** Conduct ~~his or her~~ activities ethically
Manage engineering activities: Types of activity	**EC9:** Manage part or all of one or more complex activities	**TC9:** Manage part or all of one or more broadly-defined activities	**NC9:** Manage part or all of one or more well-defined activities
Communication and Collaboration: Requirement for inclusive communications. No differentiation in this characteristic	**EC10:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all activities	**TC10:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all activities	**NC10:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all activities
Continuing Professional Development (CPD) and Lifelong learning: Preparation for and depth of continuing learning. No differentiation in this characteristic	**EC11:** Undertake CPD activities ~~sufficient~~ to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work	**TC11:** Undertake CPD activities ~~sufficient~~ to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work	**NC11:** Undertake CPD activities ~~sufficient~~ to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work
Judgement: Level of developed knowledge, and ability and judgement in relation to type of activity	**EC12:** Recognize complexity and assess alternatives in light of competing requirements and incomplete knowledge. Exercise sound judgement in the course of all complex activities	**TC12:** Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of all broadly-defined activities	**NC12:** Choose and apply appropriate technical expertise. Exercise sound judgement in the course of all well-defined activities
Responsibility for decisions: Type of activity for which responsibility is taken	**EC13:** Be responsible for making decisions on part or all of complex activities	**TC13:** Be responsible for making decisions on part or all of one or more broadly defined activities	**NC13:** Be responsible for making decisions on part or all of all of one or more well-defined activities
*Represented by the 17 UN Sustainable Development Goals (UN-SDG)			

Appendix A: Definitions of terms

Note: These definitions apply to terms used in this document.

Awareness: Recognizing the context and implications while using or applying what has been learned. The demonstration of awareness can be more varied than a demonstration of knowledge. Asking the right questions, including among the assumptions made, complying with or respecting when faced with a situation may be acceptable demonstrations.

Branch of engineering: a generally-recognized, 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 competences.

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

Engineering speciality or specialization: a generally-recognized 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 competence.

Forefront of the professional discipline/branch[4]: defined by advanced practice in the specialisations within the discipline.

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

Knowledge: Recognizing and comprehending terminology, facts, methods, trends, classifications, structures, or theories. It involves learning as well as demonstrating what has been learned. The demonstration of a specific knowledge is invariably by means of work done based on that 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-recognized engineering speciality; *at the professional level:* a generally recognized 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 programs means that two or more programs, 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.

[4] This should be distinguished from: **Forefront of knowledge in an engineering discipline/speciality**: defined by current published research in the discipline or speciality.

Appendix B: History of Graduate Attributes and Professional Competence 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 program to ensure fitness for their respective purposes.

The Engineers Mobility Forum (EMF) and Engineering Technologist Mobility Forum (ETMF)[5] 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 competence-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 competence standards for professional registration. The EMF and the ETMF therefore resolved to define assessable sets of competences 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 competences of the engineering team.

Version 1

A single process was therefore agreed to develop the three sets of graduate attributes and three professional competence 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 Competence 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 Competences 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 Competences 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.

[5] Now the IEPA and IETA respectively.

Version 4

An agreement was signed at the IEAM 2015 for International Engineering Technicians. The Agreement for International Engineering Technicians (AIET) establishes an international benchmark standard for a practicing qualified engineering technician. An agreement now exists for technicians so that the standards included among Professional Competence Profiles for an engineering technician can be applied.

A UNESCO WFEO IEA Working Group was established in November 2019 following the renewal of the WFEO-IEA MoU and the Declaration on Engineering Education that was made in Melbourne at WEC2019. The Working Group has reviewed the Graduate Attributes and Professional Competences in order to ensure that they reflect contemporary values and employer needs, cover diversity and inclusion and ethics to reflect current and emerging thinking, address the intellectual agility, creativity and innovation required of engineering decision making as well as equip engineering professionals of the future to incorporate the practices that advance the United Nations Sustainable Development Goals (UN SDG). The main changes that resulted from the surveys, research, dissemination and consultation efforts during 2019-2021 were as follows:

- There were changes in all tables on Range of Problem Solving, Range of Engineering Activities, Knowledge and Attitude Profile, Graduate Attributes, and Professional Competence Profiles. These consisted of additions of new attributes as well as enhancements of the already existing ones. Some improvements in the wording and in clarity has also been a concern.
- Knowledge and Attitude Profile, Graduate Attributes, and Professional Competence Profiles Tables now refer to UN SDG. These references are intended to provide context for curriculum designers and for professional engineers seeking registration. They represent an internationally accepted example of how sustainability issues can be concisely understood and presented.
- Two rows on "Consequences, Judgement" at the end of Table 4.1 Range of Problem Solving that refer to Professional Competences are deleted as no differentiation was deemed necessary among the three categories.
- A new row of "Ethics, inclusive behavior and conduct" is introduced in the Knowledge Profile table, the name of which has been changed to the Knowledge and Attitude Profile.
- The breadth required of engineering education has been widened to emphasize digital literacy, data analysis, UN SDG, knowledge of relevant social sciences.
- Two rows of Graduate Attributes on "The Engineer and Society" and "Environment and Sustainability," which have been based on the same knowledge profile have been combined under the heading "The Engineer and the World," also supplementing the required knowledge profile.
- Knowledge and awareness of ethics, diversity, and inclusion have been emphasized.
- Critical thinking, innovation, emerging technologies, and lifelong learning requirements have been highlighted.
- The necessitated similar changes to Professional Competences have also been made.

The proposed revisions were introduced and discussed by member organizations through a series of extensive consultations, also through webinars organized by WFEO, in IEAM 2020 by IEA members, and via consultation web pages.