Are Australian and American Engineering Education Programs the Same? The Similarities and Differences between Australian and American Engineering Accreditation Procedures

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Abstract

In our ever more globally connected world, one of the principal objectives for engineering education accreditation standards is to maintain the international standard of quality of our engineering graduates. However, most of the world's engineering education accreditation guidelines are administered by organizations that are regulated at the national level, while the International Engineering Alliance provides comparison at the international level. At many steps in the Australian and United States accreditation processes there are similarities between the engineering education accreditation standards and procedures administered by ABET in the United States, and by Engineers Australia (IEAust) in Australia. But, there are also many differences. This paper is a comparative study that assesses the major differences and similarities between the two different engineering education accreditation infrastructures in Australia and the United States. Although in many cases the required standards for the graduate are very similar, the methods by which those standards are assessed throughout the course of the accreditation process differs considerably. The application for accreditation, the accreditation assessment procedures and the duration of accreditation tenure are all different between the two countries, and yet similar in structure. In both countries, the accreditation process is primarily directed at insuring the competence of graduates from all accredited educational providers. Accreditation is also a requirement for domestic Professional Engineering certification and licensure in both Queensland and Western Australia in Australia, as well as throughout the United States. Due to the focus of engineering education accreditation entities being focused predominantly on national issues, like domestic certification and licensure, the broader picture of international standards of engineering accreditation has necessarily received less attention. There are several multi-national accords that allow for reciprocal recognition of accredited engineering programs for the purpose of Professional Engineering certification and licensure. But, the policies and procedures of the engineering education accreditation infrastructure are far from standardized at the international level. This paper analyzes procedural differences in engineering education accreditation protocols between Australia and the United States.

Background History of the International Accords

There are numerous Mutual Recognition Agreements between national accreditation entities, which are either bilateral or multinational in nature. These MRAs are agreements made between primary accrediting entities from two or more nations that agree to reciprocally recognize the engineering education programs that are separately accredited by each of the national accrediting entities. In regard to this paper, there are principally only three MRAs that are applicable to the specific field of engineering education. The first, and most prominent of these MRAs, is the Washington Accord, which was signed by six nations' engineering education accreditation entities in 1989. The original six signatories to the Washington Accord in 1989 are:[1]

1. Engineers Australia (also referred to as IEAust)
2. The Canadian Council of Professional Engineers

3. Engineers Ireland (also referred to as IEIreland)
4. The Institution of Professional Engineers, New Zealand
5. The Engineering Council (representing the UK)
6. The Accreditation Board of Engineering and Technology (representing the USA)

These six original signatories created a framework of reciprocal cross-recognition of accredited engineering education programs that made each nation's programs acceptable for professional certification in each of the other signatory nations. The value of being a signatory to the Washington Accord was immediately recognizable to each of the original signatory nations. It was with great foresight that the individuals that originally designed the Washington Accord saw how the world was becoming a global marketplace. Professional engineers, with the ability to receive full professional certification in each of these six major national economies, would be in high demand as the world began to think and act globally. In that way, each of the signatories to the Washington Accord also directly benefitted each of their own constituent institutions by giving those institutions' graduates a much more global marketplace in which to pursue their careers. Since 1989, many other nations have realized the benefits of being a signatory to the Washington Accord. The national accrediting entities that have become signatories to the accord since 1989 are listed below, in order of their signatory date.[1]

1. The Hong Kong Institution of Engineers (1995)
2. The Engineering Council of South Africa (1999)
3. Japan Accreditation Board for Engineering Education (2005)
4. The Institution of Engineers Singapore (2006)
5. The Institute of Engineering Education Taiwan (2007)
6. Accreditation Board for Engineering Education of Korea (2007)
7. The Board of Engineers Malaysia (2009)
8. The Assoc. for Evaluation and Accreditation of Eng. Programs (MUDEK-Turkey) (2011)
9. The Association for Engineering Education of Russia (2012)

These additional nine signatories bring the total number of nations whose accreditation entities have signed the Washington Accord to 15 members. The additional nine members also represent a large expansion of the engineering graduates who now are included in the accord, and subsequently have the ability to become globally certified and employable. In addition to the 15 current signatories to the accord, there are also five provisional accreditation entities that are modifying their accreditation protocols, with a view of becoming signatory members. However, currently, the 15 signatory accreditation entities still do not recognize the equivalency of engineering programs offered in the nations that still remain in provisional status. Those national accreditation entities that have provisional status are:[2]

1. Board of Accreditation for Engineering and Technical Education (representing Bangladesh)*
2. German Accreditation Agency for Study Programs in Engineering and Informatics*
3. National Board of Accreditation of All India Council for Technical Education*
4. Pakistan Engineering Council*
5. Institution of Engineers Sri Lanka*

*Provisional Status Granted

Although the focus of this paper is specifically on engineering education accreditation procedures in Australia and the United States, it is worth mentioning that there are two other multinational MRAs that also address accreditation equivalency for two other professional levels of certification in engineering. The international accord that specifically looks at cross-recognition of accreditation entities for engineering technology education is the Sydney Accord. The Sydney Accord was originally signed in 2001 by the seven original signatory nations listed below. In addition to the original seven signatory accreditation entities, The Accreditation Board of Engineering and Technology, representing the USA, became a further signatory to the Sydney Accord in 2009. Therefore, the eight current signatories to the Sydney Accord are listed below, with an additional two provisional members, which are currently working toward signatory status.[3]

1. Engineers Australia
2. The Canadian Council of Technicians and Technologists
3. Engineers Ireland
4. The Institution of Professional Engineers, New Zealand
5. The Engineering Council (representing the UK)
6. The Accreditation Board of Engineering and Technology (representing the USA)
7. The Hong Kong Institution of Engineers
8. The Engineering Council of South Africa
9. The Institute of Engineering Education Taiwan*
10. Accreditation Board for Engineering Education of Korea*

*Provisional Status Granted

The third international accord that addresses accreditation equivalency for engineering technician education is referred to as the Dublin Accord, and was signed in 2002 by the following four national accreditation entities, with an additional four provisional members.[4]

1. The Canadian Council of Technicians and Technologists
2. Engineers Ireland
3. The Engineering Council (representing the UK)
4. The Engineering Council of South Africa
5. The Institution of Professional Engineers, New Zealand*
6. The Accreditation Board of Engineering and Technology (representing the USA)*
7. Accreditation Board for Engineering Education of Korea*
8. Engineers Australia*

*Provisional Status Granted

As can be seen by the list of signatories to the Dublin Accord, both Engineers Australia and ABET (US) are represented as provisional members, rather than as signatory entities. As stated previously, this paper is not concerned with the MRAs that apply specifically to Engineering Technologists or Engineering Technicians. Future papers may concentrate on the globalization of those professional qualifications.

The Similarities between IEAust and ABET Entry-level Engineering Criteria

Examining all of the Program Educational Objectives and Student Outcomes that help form the framework of ABET's accreditation criteria, as well as examining the Stage 1 Competencies set out by Engineers Australia would require a monograph, rather than simply a contributed paper. However, there are similarities and differences between the two outcome-based criteria that the two separate accreditation entities signify are the typical competencies for an entry level Professional Engineer. ABET's Student Outcomes, as shown below in the column to the left, represent the typical profile that all entry-level engineers should have when they begin their careers.[5] The Stage One Competency Standards are the equivalent typical attributes that an entry-level engineer would be required to demonstrate for Engineers Australia. As can be seen from Table 1 below, many of the Student Outcomes stipulated by ABET have their parallels in parts of the Stage One Competencies. However, the Engineers Australia Stage One Competencies are a super-set of ABET's Student Outcomes. Those competencies that are parallels to the ABET Student Outcomes are shown below in the column to the left.[6]

Table 1.1: Similarities of ABET Student Outcomes and IEAust Stage One Competencies

Student Outcomes-ABET	Stage 1 Competencies and Elements of Competency-IEAust
(a) an ability to apply knowledge of mathematics, science, and engineering	1.1 Engages with the engineering discipline at a phenomenological level, applying sciences and engineering fundamentals to systematic investigation, interpretation, analysis and innovative solution of complex problems and broader aspects of engineering practice.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	2.2 f, g and h) Designs and conducts experiments, analyses and interprets result data and formulates reliable conclusions. Analyses sources of error in applied models and experiments; eliminates, minimizes or compensates for such errors; quantifies significance of errors to any conclusions drawn. Safely applies laboratory, test and experimental procedures appropriate to the engineering discipline.
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	2.1 d, g and i) Competently addresses engineering problems involving uncertainty, ambiguity, imprecise information and wide-ranging and sometimes conflicting technical and non-technical factors. Identifies, quantifies, mitigates and manages technical, health, environmental, safety and other contextual risks associated with engineering application in the designated engineering discipline. Investigates complex problems using research-based knowledge and research methods. 1.5 a-e) Identifies and understands the interactions between engineering systems and people in the social, cultural, environmental, commercial, legal and political contexts in which they operate, including both the positive role of engineering in sustainable development and the potentially adverse impacts of engineering activity in the engineering discipline. Is aware of the founding principles of human factors relevant to the engineering discipline. Is aware of the fundamentals of business and enterprise management. Identifies the structure, roles and capabilities of the engineering workforce. Appreciates the issues associated with international engineering practice and global operating contexts. 1.6 a, d and f) Applies systematic principles of engineering design relevant to the engineering discipline. Appreciates the social, environmental and economic principles of sustainable engineering practice. Appreciates the formal structures and methodologies of systems engineering as a holistic basis for managing complexity and sustainability in engineering practice. 2.2 e) Applies formal systems engineering methods to address the planning and execution of complex, problem solving and engineering projects. 2.3 a) Proficiently applies technical knowledge and open ended problem solving skills as well as appropriate tools and resources to design components, elements, systems, plant, facilities and/or processes to satisfy user requirements. 2.4 f) Demonstrates commitment to sustainable engineering practices and the achievement of sustainable outcomes in all facets of engineering project work.
(d) an ability to function on multidisciplinary teams	3.6 b) Functions as an effective member or leader of diverse engineering teams, including those with multilevel, multi-disciplinary and multi-cultural dimensions.
(e) an ability to identify, formulate, and solve engineering problems	2.1 a-c) Identifies, discerns and characterizes salient issues, determines and analyses causes and effects, justifies and applies appropriate simplifying assumptions, predicts performance and behavior, synthesizes solution strategies and develops substantiated conclusions. Ensures that all aspects of an engineering activity are soundly based on fundamental principles – by diagnosing, and taking appropriate action with data, calculations, results, proposals, processes, practices, and documented information that may be ill-founded, illogical, erroneous, unreliable or unrealistic.

	Competently addresses engineering problems involving uncertainty, ambiguity, imprecise information and wide-ranging and sometimes conflicting technical and non-technical factors.
(f) an understanding of professional and ethical responsibility	3.1 a-d) Demonstrates commitment to uphold the Engineers Australia - Code of Ethics, and established norms of professional conduct pertinent to the engineering discipline. Understands the need for 'due-diligence' in certification, compliance and risk management processes. Understands the accountabilities of the professional engineer and the broader engineering team for the safety of other people and for protection of the environment. Is aware of the fundamental principles of intellectual property rights and protection.
(g) an ability to communicate effectively	3.2 a-b) Is proficient in listening, speaking, reading and writing English, including: comprehending critically and fairly the viewpoints of others; expressing information effectively and succinctly, issuing instruction, engaging in discussion, presenting arguments and justification, debating and negotiating - to technical and non-technical audiences and using textual, diagrammatic, pictorial and graphical media best suited to the context; representing an engineering position, or the engineering profession at large to the broader community; appreciating the impact of body language, personal behavior and other non-verbal communication processes, as well as the fundamentals of human social behavior and their cross-cultural differences. Prepares high quality engineering documents such as progress and project reports, reports of investigations and feasibility studies, proposals, specifications, design records, drawings, technical descriptions and presentations pertinent to the engineering discipline.
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	2.3 b) Addresses broad contextual constraints such as social, cultural, environmental, commercial, legal political and human factors, as well as health, safety and sustainability imperatives as an integral part of the design process. 3.3 c) Is aware of broader fields of science, engineering, technology and commerce from which new ideas and interfaces may be drawn and readily engages with professionals from these fields to exchange ideas.
(i) a recognition of the need for, and an ability to engage in life-long learning	3.5 c) Demonstrates commitment to life-long learning and professional development.
(j) a knowledge of contemporary issues	2.4 c) Accommodates relevant contextual issues into all phases of engineering project work, including the fundamentals of business planning and financial management
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	2.2 a-d) Proficiently identifies, selects and applies the materials, components, devices, systems, processes, resources, plant and equipment relevant to the engineering discipline. Constructs or selects and applies from a qualitative description of a phenomenon, process, system, component or device a mathematical, physical or computational model based on fundamental scientific principles and justifiable simplifying assumptions. Determines properties, performance, safe working limits, failure modes, and other inherent parameters of materials, components and systems relevant to the engineering discipline. Applies a wide range of engineering tools for analysis, simulation, visualization, synthesis and design, including assessing the accuracy and limitations of such tools, and validation of their results.

The full Engineers Australia Stage One Competency requirements are included in Appendix A of this paper. As can be seen from reviewing the IEAust Stage 1 Competencies in Appendix A, the IEAust Competencies demonstrate much more expansive outcomes-based specifications than are detailed in the ABET Student Outcomes requirements.

The Differences between IEAust and ABET Entry-level Engineering Criteria

The differences between the ABET Student Outcomes and the IEAust Stage One Competencies are in the details, rather than in the intent of the two outcome-based assessment criterion. For instance, the ABET Student Outcomes never specifically mention that the entry-level engineer should have an understanding of "the basis and relevance of standards and codes of practice". It could be argued that that outcome is vaguely implied in ABET Student Outcomes f, h and k, but not specifically stated anywhere. In the following three Tables, numerous other specific IEAust Stage 1 Competencies that do not have specific stated parallels in the ABET Student Outcomes a-k are discussed. Please refer to the "Comments" column concerning the stated differences.

Table 1.2: Differences between IEAust Stage 1 Knowledge and Skill Base and ABET Student Outcomes

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT	Comments
1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer	a) Develops and fluently applies relevant investigation analysis, interpretation, assessment, characterization, prediction, evaluation, modeling, decision making, measurement, evaluation, knowledge	ABET Student Outcomes does not specify that the Entry-level engineer must understand

and information sciences which underpin the engineering discipline.	management and communication tools and techniques pertinent to the engineering discipline.	probability, statistics and computer sciences as stipulated in the Element of Competency
1.3 In depth understanding of specialist bodies of knowledge within the engineering discipline.	a) Proficiently applies advanced technical knowledge and skills in at least one specialist practice domain of the engineering discipline.	ABET Student Outcomes does not specify that the Entry-level engineer must be a specialist in one discipline of engineering
1.4 Discernment of knowledge development and research directions within the engineering discipline.	a) Identifies and critically appraises current developments, advanced technologies, emerging issues and interdisciplinary linkages in at least one specialist practice domain of the engineering discipline. b) Interprets and applies selected research literature to inform engineering application in at least one specialist domain of the engineering discipline.	ABET Student Outcomes does not specify that the Entry-level engineer must understand contemporary research directions within engineering
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the engineering discipline.	b) Appreciates the basis and relevance of standards and codes of practice, as well as legislative and statutory requirements applicable to the engineering discipline. c) Appreciates the principles of safety engineering, risk management and the health and safety responsibilities of the professional engineer, including legislative requirements applicable to the engineering discipline. e) Understands the fundamental principles of engineering project management as a basis for planning, organizing and managing resources.	ABET Student Outcomes does not specify that the Entry-level engineer should understand engineering standards, design codes or statutory requirements. Nor does it specify safety requirements, ergonomics or project management.

Table 1.3: Differences between IEAust Stage 1 Engineering Application Ability and ABET Student Outcomes

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT	Comments
2.1 Application of established engineering methods to complex engineering problem solving.	e) Conceptualizes alternative engineering approaches and evaluates potential outcomes against appropriate criteria to justify an optimal solution choice. f) Critically reviews and applies relevant standards and codes of practice underpinning the engineering discipline and nominated specializations. h) Interprets and ensures compliance with relevant legislative and statutory requirements applicable to the engineering discipline.	ABET Student Outcomes does not specify that the Entry-level engineer should use alternative approaches, optimal solutions or work to relevant standards.
2.2 Fluent application of engineering techniques, tools and resources.	i) Understands the need for systematic management of the acquisition, commissioning, operation, upgrade, monitoring and maintenance of engineering plant, facilities, equipment and systems. j) Understands the role of quality management systems, tools and processes within a culture of continuous improvement.	ABET Student Outcomes does not specify that the Entry-level engineer needs to understand systematic management processes, facilities design or the role of quality management systems.
2.3 Application of systematic engineering synthesis and design processes.	c) Executes and leads a whole systems design cycle approach including tasks such as: - determining client requirements and identifying the impact of relevant contextual factors, including business planning and costing targets; - systematically addressing sustainability criteria; - working within projected development, production and implementation constraints; - eliciting, scoping and documenting the required outcomes of the design task and defining acceptance criteria; - identifying assessing and managing technical, health and safety risks integral to the design process; - writing engineering specifications, that fully satisfy the formal requirements; - ensuring compliance with essential engineering standards and codes of practice; - partitioning the design task into appropriate modular, functional elements; that can be separately addressed and subsequently integrated through defined interfaces; - identifying and analyzing possible design approaches and justifying an optimal approach; - developing and completing the design using appropriate engineering principles, tools, and processes; - integrating functional elements to form a coherent design solution; - quantifying the materials, components, systems, equipment, facilities, engineering resources and operating arrangements needed for implementation of the solution; - checking the design solution for each element and the integrated system against the engineering specifications; - devising and documenting tests that will verify performance of the	ABET Student Outcomes does not specify that the Entry-level engineer should approach tasks with a view to holistic systems design, including business planning and costing targets. Although the design process is mentioned in the ABET Student Outcomes, it has not been laid out in such detail as is shown at left.

	elements and the integrated realization; - prototyping/implementing the design solution and verifying performance against specification; - documenting, commissioning and reporting the design outcome. d) Is aware of the accountabilities of the professional engineer in relation to the 'design authority' role.	
2.4 Application of systematic approaches to the conduct and management of engineering projects.	a) Contributes to and/or manages complex engineering project activity, as a member and/or as leader of an engineering team. b) Seeks out the requirements and associated resources and realistically assesses the scope, dimensions, scale of effort and indicative costs of a complex engineering project. d) Proficiently applies basic systems engineering and/or project management tools and processes to the planning and execution of project work, targeting the delivery of a significant outcome to a professional standard. e) Is aware of the need to plan and quantify performance over the full life-cycle of a project, managing engineering performance within the overall implementation context.	ABET Student Outcomes does not specify that the Entry-level engineer should have the rigorous training in Project Management that is detailed in the Element of Competency that is detailed to the left.

Table 1.4: Differences between IEAust Stage 1 Professional and Personal Attributes and ABET Student Outcomes

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT	Comments
3.3 Creative, innovative and pro-active demeanor.	a) Applies creative approaches to identify and develop alternative concepts, solutions and procedures, appropriately challenges engineering practices from technical and non-technical viewpoints; identifies new technological opportunities. b) Seeks out new developments in the engineering discipline and specializations and applies fundamental knowledge and systematic processes to evaluate and report potential.	ABET Student Outcomes does not specify that the Entry-level engineer must seek to always be creative and pursue alternative problem solutions. Nor does it specify that the engineer must always be seeking out new developments to assist them with their problem solutions.
3.4 Professional use and management of information.	a) Is proficient in locating and utilizing information - including accessing, systematically searching, analyzing, evaluating and referencing relevant published works and data; is proficient in the use of indexes, bibliographic databases and other search facilities. b) Critically assesses the accuracy, reliability and authenticity of information. c) Is aware of common document identification, tracking and control procedures.	ABET Student Outcomes does not specify that the Entry-level engineer should be an expert in information accessing, processing and referencing. Nor does it specify that the engineer should be fluent in document searching and publication.
3.5 Orderly management of self and professional conduct.	a) Demonstrates commitment to critical self-review and performance evaluation against appropriate criteria as a primary means of tracking personal development needs and achievements. b) Understands the importance of being a member of a professional and intellectual community, learning from its knowledge and standards, and contributing to their maintenance and advancement. d) Manages time and processes effectively, prioritizes competing demands to achieve personal, career and organizational goals and objectives. e) Thinks critically and applies an appropriate balance of logic and intellectual criteria to analysis, judgment and decision making. f) Presents a professional image in all circumstances, including relations with clients, stakeholders, as well as with professional and technical colleagues across wide ranging disciplines.	ABET Student Outcomes does not specify that the Entry-level engineer should constantly be committed to self-review and personal development. Lifelong learning does not equate to professional development. Nor does it specify the importance of time management. Nor does it require a "professional image" at all times.
3.6 Effective team membership and team leadership.	a) Understands the fundamentals of team dynamics and leadership. c) Earns the trust and confidence of colleagues through competent and timely completion of tasks. d) Recognizes the value of alternative and diverse viewpoints, scholarly advice and the importance of professional networking. e) Confidently pursues and discerns expert assistance and professional advice. f) Takes initiative and fulfils the leadership role whilst respecting the agreed roles of others.	ABET Student Outcomes does not specify that the Entry-level engineer must have team leadership capabilities. It states that the engineer must be able to function on multidisciplinary teams, but it does not require them to be leaders of the team, whereas Australian entry-level engineers must also be leaders.

As can be seen from the previous three Tables, the IEAust Stage 1 Competencies are much more detailed and specific as to what an Australian entry-level engineer should be when they graduate into the workforce, as compared to the more indefinite ABET Student Outcomes. The predominant reason for this is that the IEAust Stage 1 Competencies are also determinant of the skills that an entry-level engineer should have when gaining certification as a practicing engineer within Engineers Australia. The ABET Student Outcomes are more designed from an academic accreditation purpose, rather than professional certification as a practicing engineer, which is usually performed by the Professional Societies of the respective engineering discipline.

Differences between Application, Assessment and Duration of Program Accreditation

In addition to the differences between entry-level engineering attributes, there are also differences in the structure of the Accreditation Management Systems (AMS) that are used by ABET and Engineers Australia in accrediting educational programs in each of their separate countries. These differences are not major, but are highlighted in the differences in the application procedures, assessment evaluations and program accreditation duration time periods. As can be seen from the comparison Table 1.5 shown below, there are many similarities, but there are also several major differences.

Table 1.5: Comparison of ABET and IEAust Accreditation Management Policies and Procedures

Accreditation Management Systems Parameter	ABET Procedural Structure	IEAust Procedural Structure
Accreditation Cycle Time Duration	Full Period—6 years	Full Period—5 years
Application for Accreditation	No request for provisional accreditation. Request for Evaluation—Only after the program has produced graduates	Request for provisional accreditation occurs when a program begins enrolling students. Request for full accreditation occurs when the program has produced graduates
Duration of the Accreditation Process	18 months from the application for a Request for Evaluation for full accreditation	6-8 months for provisional accreditation 6-8 months for full accreditation
Assessment Timeline for an Institution's Programs	Program Evaluations follow an accreditation timeline associated with the individual programs. However, program accreditation can be aligned by a request from the institution.	Program Evaluations are grouped together so that an institution's programs are assessed together at the same time
Provisional Accreditation	Does not exist for ABET accreditation	If granted, provisional accreditation is granted when a new program begins enrolling new students.
Possible Accreditation Assessment Outcomes	NGR (Next General Review) – This action indicates that the program has no Deficiencies or Weaknesses. This action is taken only after a Comprehensive General Review and has a typical duration of six years. IR (Interim Report) – This action indicates that the program has one or more Weaknesses. The Weaknesses are such that a progress report will be required to evaluate the remedial actions taken by the institution. This action has a typical duration of two years. IV (Interim Visit) – This action indicates that the program has one or more Weaknesses. The Weaknesses are such that an on-site review will be required to evaluate the remedial actions taken by the institution. This action has a typical duration of two years. SCR (Show Cause Report) – This action indicates that a currently accredited	Accredited Not Accredited—an appeals process is available that will re-assess the decision, and may re-visit the institution and program. The appeal sub-committee's decision is final. Sometimes an interim report is required within 12 months of a visit to address specific problems.

	program has one or more Deficiencies. The Deficiencies are such that a progress report will be required to evaluate the remedial actions taken by the institution. This action has a typical duration of two years. This action cannot follow a previous SC action for the same Deficiency(s). SCV (Show Cause Visit) - This action indicates that a currently accredited program has one or more Deficiencies. The Deficiencies are such that an on-site review will be required to evaluate the remedial actions taken by the institution. This action has a typical duration of two years. This action cannot follow a previous SC action for the same Deficiencies RE (Report Extended) – This action indicates that satisfactory remedial action has been taken by the institution with respect to Weaknesses identified in the prior IR action. This action is taken only after an IR review. This action extends accreditation to the next General Review and has a typical duration of either two or four years. VE (Visit Extended) -- This action indicates that satisfactory remedial action has been taken by the institution with respect to Weaknesses identified in the prior IV action. This action is taken only after an IV review. This action extends accreditation to the next General Review and has a typical duration of either two or four years. SE (Show Cause Extended) -- This action indicates that satisfactory remedial action has been taken by the institution with respect to all Deficiencies and Weaknesses identified in the prior SC action. This action is taken only after either a SCR or SCV review. This action typically extends accreditation to the next General Review and has a typical duration of either two or four years. NA (Not to Accredit) -- This action indicates that the program has Deficiencies such that the program is not in compliance with the applicable criteria. This action is usually taken only after a SCR or SCV review, or the review of a new, unaccredited program. Accreditation is not extended as a result of this action. This action can be appealed as specified in the Appeals Section (II.L.) of this document. II.G.12.i.(1)An Executive Summary of the findings leading to the not-to-accredit action will be provided to the institution along with the Final Statement. T (Terminate) – This action is generally taken in response to a request by an institution that accreditation be extended for a program that is being phased out. The intent is to provide accreditation coverage for students remaining in the program. II.G.12.j.(1) The duration of this action may be up to three years.	

As can be seen from the table above, there are major differences in the active accreditation time period, as well as the possible outcomes of the Accreditation Assessment Process. Engineers Australia either accredits or does not accredit the program, whereas ABET has numerous other possible outcomes that provide for interim visits to overcome any weaknesses or deficiencies that may have been determined during the accreditation process.

Conclusions

Despite ABET and Engineers Australia both being signatories to the Washington Accord, there remain significant differences between the two accreditation systems. This may be because the two systems have different purposes – ABET provides academic accreditation while Engineers Australia provides accreditation for the purposes of graduate membership of EA and, ultimately, Chartered membership. It seems that ABET could benefit from the very detailed description of the graduate outcomes, whereas Engineers Australia could learn from ABET's approach toward a variety of possible accreditation outcomes. Conditional accreditation, interim reports and quality assurance of the Program Outcomes are all areas in which Engineers Australia could possibly learn from reviewing ABET's standard policies and procedures.

Appendix A

Engineers Australia (IEAust) Stage 1 Competencies and Elements of Competency

Table A.1: Knowledge and Skill Base: Elements and Indicators

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT
1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	a) Engages with the engineering discipline at a phenomenological level, applying sciences and engineering fundamentals to systematic investigation, interpretation, analysis and innovative solution of complex problems and broader aspects of engineering practice.
1.2 Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	a) Develops and fluently applies relevant investigation analysis, interpretation, assessment, characterization, prediction, evaluation, modeling, decision making, measurement, evaluation, knowledge management and communication tools and techniques pertinent to the engineering discipline.
1.3 In depth understanding of specialist bodies of knowledge within the engineering discipline.	a) Proficiently applies advanced technical knowledge and skills in at least one specialist practice domain of the engineering discipline.
1.4 Discernment of knowledge development and research directions within the engineering discipline.	a) Identifies and critically appraises current developments, advanced technologies, emerging issues and interdisciplinary linkages in at least one specialist practice domain of the engineering discipline. b) Interprets and applies selected research literature to inform engineering application in at least one specialist domain of the engineering discipline.
1.5 Knowledge of contextual factors impacting the engineering discipline.	a) Identifies and understands the interactions between engineering systems and people in the social, cultural, environmental, commercial, legal and political contexts in which they operate, including both the positive role of engineering in sustainable development and the potentially adverse impacts of engineering activity in the engineering discipline. b) Is aware of the founding principles of human factors relevant to the engineering discipline. c) Is aware of the fundamentals of business and enterprise management. d) Identifies the structure, roles and capabilities of the engineering workforce. e) Appreciates the issues associated with international engineering practice and global operating contexts.
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the engineering discipline.	a) Applies systematic principles of engineering design relevant to the engineering discipline. b) Appreciates the basis and relevance of standards and codes of practice, as well as legislative and statutory requirements applicable to the engineering discipline. c) Appreciates the principles of safety engineering, risk management and the health and safety responsibilities of the professional engineer, including legislative requirements applicable to the engineering discipline. d) Appreciates the social, environmental and economic principles of sustainable engineering practice. e) Understands the fundamental principles of engineering project management as a basis for planning, organizing and managing resources. f) Appreciates the formal structures and methodologies of systems engineering as a holistic basis for managing complexity and sustainability in engineering practice.

Table A2: Engineering Application Ability: Elements and Indicators

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT
2.1 Application of established engineering methods to complex engineering problem solving.	a) Identifies, discerns and characterizes salient issues, determines and analyses causes and effects, justifies and applies appropriate simplifying assumptions, predicts performance and behavior, synthesizes solution strategies and develops substantiated conclusions. b) Ensures that all aspects of an engineering activity are soundly based on fundamental principles - by diagnosing, and taking appropriate action with data, calculations, results, proposals, processes, practices, and documented information that may be ill-founded, illogical, erroneous, unreliable or unrealistic. c) Competently addresses engineering problems involving uncertainty, ambiguity, imprecise information and wide-ranging and sometimes conflicting technical and non-technical factors. d) Partitions problems, processes or systems into manageable elements for the purposes of analysis, modeling or design and then re-combines to form a whole, with the integrity and performance of the

	overall system as the paramount consideration. e) Conceptualizes alternative engineering approaches and evaluates potential outcomes against appropriate criteria to justify an optimal solution choice. f) Critically reviews and applies relevant standards and codes of practice underpinning the engineering discipline and nominated specializations. g) Identifies, quantifies, mitigates and manages technical, health, environmental, safety and other contextual risks associated with engineering application in the designated engineering discipline. h) Interprets and ensures compliance with relevant legislative and statutory requirements applicable to the engineering discipline. i) Investigates complex problems using research-based knowledge and research methods.
2.2 Fluent application of engineering techniques, tools and resources.	a) Proficiently identifies, selects and applies the materials, components, devices, systems, processes, resources, plant and equipment relevant to the engineering discipline. b) Constructs or selects and applies from a qualitative description of a phenomenon, process, system, component or device a mathematical, physical or computational model based on fundamental scientific principles and justifiable simplifying assumptions. c) Determines properties, performance, safe working limits, failure modes, and other inherent parameters of materials, components and systems relevant to the engineering discipline. d) Applies a wide range of engineering tools for analysis, simulation, visualization, synthesis and design, including assessing the accuracy and limitations of such tools, and validation of their results. e) Applies formal systems engineering methods to address the planning and execution of complex, problem solving and engineering projects. f) Designs and conducts experiments, analyses and interprets result data and formulates reliable conclusions. g) Analyses sources of error in applied models and experiments; eliminates, minimizes or compensates for such errors; quantifies significance of errors to any conclusions drawn. h) Safely applies laboratory, test and experimental procedures appropriate to the engineering discipline. i) Understands the need for systematic management of the acquisition, commissioning, operation, upgrade, monitoring and maintenance of engineering plant, facilities, equipment and systems. j) Understands the role of quality management systems, tools and processes within a culture of continuous improvement.
2.3 Application of systematic engineering synthesis and design processes.	a) Proficiently applies technical knowledge and open ended problem solving skills as well as appropriate tools and resources to design components, elements, systems, plant, facilities and/or processes to satisfy user requirements. b) Addresses broad contextual constraints such as social, cultural, environmental, commercial, legal political and human factors, as well as health, safety and sustainability imperatives as an integral part of the design process. c) Executes and leads a whole systems design cycle approach including tasks such as: - determining client requirements and identifying the impact of relevant contextual factors, including business planning and costing targets; - systematically addressing sustainability criteria; - working within projected development, production and implementation constraints; - eliciting, scoping and documenting the required outcomes of the design task and defining acceptance criteria; - identifying assessing and managing technical, health and safety risks integral to the design process; - writing engineering specifications, that fully satisfy the formal requirements; - ensuring compliance with essential engineering standards and codes of practice; - partitioning the design task into appropriate modular, functional elements; that can be separately addressed and subsequently integrated through defined interfaces; - identifying and analyzing possible design approaches and justifying an optimal approach; - developing and completing the design using appropriate engineering principles, tools, and processes; - integrating functional elements to form a coherent design solution; - quantifying the materials, components, systems, equipment, facilities, engineering resources and operating arrangements needed for implementation of the solution; - checking the design solution for each element and the integrated system against the engineering specifications; - devising and documenting tests that will verify performance of the elements and the integrated realization; - prototyping/implementing the design solution and verifying performance against specification; - documenting, commissioning and reporting the design outcome. d) Is aware of the accountabilities of the professional engineer in relation to the ‘design authority’ role.
2.4 Application of systematic approaches to the conduct and management of engineering projects.	a) Contributes to and/or manages complex engineering project activity, as a member and/or as leader of an engineering team. b) Seeks out the requirements and associated resources and realistically assesses the scope, dimensions, scale of effort and indicative costs of a complex engineering project. c) Accommodates relevant contextual issues into all phases of engineering project work, including the fundamentals of business planning and financial management d) Proficiently applies basic systems engineering and/or project management tools and processes to

	the planning and execution of project work, targeting the delivery of a significant outcome to a professional standard. e) Is aware of the need to plan and quantify performance over the full life-cycle of a project, managing engineering performance within the overall implementation context. f) Demonstrates commitment to sustainable engineering practices and the achievement of sustainable outcomes in all facets of engineering project work.

Table A3: Professional and Personal Attributes: Elements and Indicators

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT
3.1 Ethical conduct and professional accountability	a) Demonstrates commitment to uphold the Engineers Australia - Code of Ethics, and established norms of professional conduct pertinent to the engineering discipline. b) Understands the need for 'due-diligence' in certification, compliance and risk management processes. c) Understands the accountabilities of the professional engineer and the broader engineering team for the safety of other people and for protection of the environment. d) Is aware of the fundamental principles of intellectual property rights and protection.
3.2 Effective oral and written communication in professional and lay domains.	a) Is proficient in listening, speaking, reading and writing English, including: - comprehending critically and fairly the viewpoints of others; - expressing information effectively and succinctly, issuing instruction, engaging in discussion, presenting arguments and justification, debating and negotiating - to technical and non-technical audiences and using textual, diagrammatic, pictorial and graphical media best suited to the context; - representing an engineering position, or the engineering profession at large to the broader community; - appreciating the impact of body language, personal behavior and other non-verbal communication processes, as well as the fundamentals of human social behavior and their cross-cultural differences. b) Prepares high quality engineering documents such as progress and project reports, reports of investigations and feasibility studies, proposals, specifications, design records, drawings, technical descriptions and presentations pertinent to the engineering discipline.
3.3 Creative, innovative and pro-active demeanor.	a) Applies creative approaches to identify and develop alternative concepts, solutions and procedures, appropriately challenges engineering practices from technical and non-technical viewpoints; identifies new technological opportunities. b) Seeks out new developments in the engineering discipline and specializations and applies fundamental knowledge and systematic processes to evaluate and report potential. c) Is aware of broader fields of science, engineering, technology and commerce from which new ideas and interfaces may be may drawn and readily engages with professionals from these fields to exchange ideas.
3.4 Professional use and management of information.	a) Is proficient in locating and utilizing information - including accessing, systematically searching, analyzing, evaluating and referencing relevant published works and data; is proficient in the use of indexes, bibliographic databases and other search facilities. b) Critically assesses the accuracy, reliability and authenticity of information. c) Is aware of common document identification, tracking and control procedures.
3.5 Orderly management of self and professional conduct.	a) Demonstrates commitment to critical self-review and performance evaluation against appropriate criteria as a primary means of tracking personal development needs and achievements. b) Understands the importance of being a member of a professional and intellectual community, learning from its knowledge and standards, and contributing to their maintenance and advancement. c) Demonstrates commitment to life-long learning and professional development. d) Manages time and processes effectively, prioritizes competing demands to achieve personal, career and organizational goals and objectives. e) Thinks critically and applies an appropriate balance of logic and intellectual criteria to analysis, judgment and decision making. f) Presents a professional image in all circumstances, including relations with clients, stakeholders, as well as with professional and technical colleagues across wide ranging disciplines.
3.6 Effective team membership and team leadership.	a) Understands the fundamentals of team dynamics and leadership. b) Functions as an effective member or leader of diverse engineering teams, including those with multilevel, multi-disciplinary and multi-cultural dimensions. c) Earns the trust and confidence of colleagues through competent and timely completion of tasks. d) Recognizes the value of alternative and diverse viewpoints, scholarly advice and the importance of professional networking. e) Confidently pursues and discerns expert assistance and professional advice. f) Takes initiative and fulfils the leadership role whilst respecting the agreed roles of others.

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