

IEA Graduate Attributes: Adapted to Global Engineering Challenges

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Program Accreditation

Educational Accreditation is a process of *quality assurance*. It is the act of certifying whether an educational institution or program meets specified requirements of academic achievement, level of facilities, appropriateness of curriculum, and the like.

Outcome-Based Accreditation primarily assesses whether the graduate (completed product!) meets the defined expectations, called «outcomes» or «attributes».

In the service sector of *education*, there are **institutional accreditation** and **program accreditation** activities. The first makes a wholesome evaluation of the institution (university, college, school) in which there are many programs.

Program accreditation is a much closer look at a specific program through the eyes of peer experts on that type of program.

Engineering Accreditation

Our focus is on *program* accreditation and on 4-5 year long engineering education programs: There are two main umbrella organizations that ally program accreditation agencies such as Acredita CI:

- *European Network for Accreditation of Engineering Education (ENAAEE)* that has 21 members, 15 of which offer EUR-ACE Label Accreditation.
- *International Engineering Alliance (IEA)* that has 23 signatories with accreditations having Washington Accord Equivalence distinction.

The membership of an agency into each IEA and ENAAEE requires that the agency uses «equivalent procedures» and «equivalent criteria» while accrediting programs.

The top criterion is what «outcomes» or «attributes» are required of an engineering graduate.

GAPC: Purpose, Context, Scope

The IEA Rules and Procedures definitions for GA and PC:

Graduate attributes form a set of individually assessable outcomes that are the components indicative of the **graduate's potential** to acquire competence **to practice** at the appropriate level. The attributes are clear, succinct statements of the expected capability.

The graduate attributes identify the distinctive roles of *engineers, technologists and technicians*

Professional competency profiles record the elements of competency necessary for competent performance that the professional is expected to be able to demonstrate in a holistic way at the stage of **attaining registration**.

Relevance of GA and Its Versions

IEA Rules and Procedures Document Requires that

“The *graduate outcomes standard* applied for accreditation [by a signatory] is substantially equivalent to that of the Accord graduate attributes exemplar.”

GAPC was first developed in 2005 to serve as an example for signatories and for to-be-signatories. It has been reviewed/revise in 2009 and 2013.

UNESCO WFEO IEA Working Group, established in November 2019, prepared Version 4 that has been accepted by the signatories in 2021.

By 2026, every signatory is expected to use outcomes that are “equivalent” to attributes in GAPC Version 4.

New Features

It is a joint product by WFEO* and IEA, supported by UNESCO

GAPC Version 4 took into account the information emerging from recent review works undertaken by Agreement members and Accord signatories, e.g. ECUK* Standards Review (2019), ACED* Engineering 2035 (2019/20), and others.

It spent great time and effort to

- cover emerging technologies
- cover emerging engineering disciplines
- be aligned with the UN Sustainable Development Goals
- cover diversity and inclusion and ethics to reflect current and emerging thinking
- meet expectations regarding the intellectual agility, creativity and innovation, and professional judgement

* World Federation of Engineering Organizations *Engineering Council, UK *Australian Council of Engineering Deans

Guiding Principles of Review

GAPC

- is not an “international standard” but provides a basis for judgement of substantial equivalence
 - is not prescriptive in detail but rather reflects the essential elements
 - does not specify performance indicators for assessment
 - is applicable to all engineering disciplines, i.e. it is discipline-independent.
- While being revised, views have been collected from many
 - Professional Engineering Organizations and
 - Accreditation Agencies
 - Made sure that any additions are "assessable“ attributes/competencies
 - Tried to avoid going too much into details
 - Was aware that "no action" decision is as respectable as "action"

Five Tables Characterize GAPC

- 1. Range of Problem Solving Capabilities** distinguish the 4-5-year programs with engineer graduates from those that have a teaching duration of 3-4 years for technologists or from 2 years for graduating technicians
- 2. Range of Engineering Activities define** complex activities for an engineer, broadly-defined activities for a technologist, and well-defined activities for a technician
- 3. Knowledge and Attitude Profile** can be viewed as describing what the curriculum of an engineering program must contain at a minimum
- 4. Graduate Attribute Profiles** are qualifications (assimilated knowledge, skills, and attitudes) of an engineer or technologist or technician at the time of graduation
- 5. Professional Competency Profiles are** capabilities of a qualified engineer or technologist or technician, attained not only during school education but also through lifelong learning and professional development.

Example on Ethics

<p>(Table 4: Graduate Attributes) Ethics: Understanding and level of practice</p>	<p>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)</p>
<p>(Table 3: Knowledge and Attitude Profile)</p>	<p>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</p>
<p>(Table 1: Range of Problem Identification and Solving) Range of conflicting requirements</p>	<p>WP2: Involve wide-ranging and/or conflicting technical, non-technical issues (such as ethical, sustainability, legal, political, economic, societal) and consideration of future requirements</p>

- “**Ethics**” row of **Table 4** includes engineering codes, standards, specifications, diversity, and relevant laws.
- Table 3 stipulates that professional ethics and norms are acquired as **knowledge** and “diversity and inclusion” as **awareness**.
- The items of Table 3 and Table 4 are based upon Table 1, where it is indicated that problem identification and solving must involve ethical, legal, societal requirements.

What a change in GA necessitates

The following questions must be in mind, whenever a new entry or change in Table 4 is made:

Is this consistent with Range of Activities Table 2?

Is this consistent with Knowledge and Attitude Table 3?

Is this attainable in the relevant program?

Is this measurable?

Is this assessable?

Is this demonstrable?

Example on emerging technologies and disciplines

<p>(Table 4: Graduate Attributes)</p> <p>Modern Digital Tool Usage: Level of understanding of the appropriateness of technologies and various tools</p>	<p>WA5: Create, select and apply appropriate techniques, including prediction and modelling, computing and information tools, and data analytics and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (WK6)</p>
<p>(Table 3: Knowledge and Attitude Profile)</p>	<p>WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline</p>
<p>(Table 2 : Range of Engineering Activities)</p> <p>Range of resources</p>	<p>EA1: Involve the use of diverse resources (and for this purpose resources includes including people, data and information, natural, financial and physical resources and appropriate technologies money, equipment, materials, information and technologies)</p>

The new entry “data analytics” in Tool Usage-row is consistent and is supported by the item “knowledge of engineering practice” in Table 3 and by the item “diverse resources” in Table 2.

The attribute is added after due consideration on whether it is assessable, measurable, demonstrable via the documents of individual students’ work in the span of 4 years.

As an example to the contrary, other suggested items like “database systems” or “parallel computing” were deemed to be discipline dependent. They are not realizable by any other engineering program than computer engineering!

Difficulty of Assessment

Evaluators for accreditation need to be aware of one difficulty while examining the evidences and judging whether a graduate has attained a particular attribute or not.

Outcome based evaluation or assessment involves *performance evaluation* at its core.

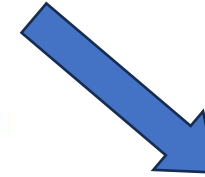
Whether a student has attained a GA or not is as difficult to determine as whether an academician has reached a level of, say, professorship or not.

(Similarly, whether an engineer has attained a PC is as difficult to determine as whether a company product satisfies a required specification or not.)

The level of difficulty is no less.

To Attain Outcomes, Inputs are Necessary

- Inputs (facilities, able teachers, required courses, etc.) ensure that the outcomes have a **chance** to be achieved.
- They are important and occur as integral parts of all «outcome based criteria» as well.



- Inputs are necessary but not always sufficient!

ABET 2000 Criteria



The New Features in GA Version 4

1. Explanation of Some Terminology
2. Enhancement or Additions via Keywords

Attributes can be divided into two subsets

Hard vs. Soft: It is generally agreed that it is easier to assess knowledge and practical skills than higher level cognitive or social skills. To assess attitudes and values may be even more challenging.

Hard and soft attributes thus require different types of evidences of attainment.

GAPC document uses cognitive words

“knowledge, understanding, and awareness”

in order to indicate the possible levels of required demonstrations. These are defined in the glossary of GAPC and are operational definitions!

Knowledge and Awareness: Operational Definitions

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.

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.

Understanding \approx Knowledge

Knowledge (Understanding) and Awareness

Table 3 Knowledge and Attitude Profile

A Washington Accord program provides:	
WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences	<p>"Awareness" is less than "knowledge" and more than "acquaintance" or "familiarity." <i>Imagine a situation that may distinguish "knowledge" and "awareness":</i></p> <p>Awareness: A curriculum has social sciences electives in a restricted pool of courses that are relevant to the discipline and requires that every student takes one (or more) course and discusses some «social aspects or implications» in a major work (HW, term paper, exam).</p> <p>Knowledge: Natural sciences courses are must courses and, in a present or a consecutive course, the HEI program shows additional student work in which the learning and understanding of the main subject matter is evident.</p>

Awareness: Inclusion among Assumptions Made

Knowledge and Attitude Profile, WK1 contains "awareness of relevant social sciences."

Demonstration by way of " **including among assumptions made** "

A robot is designed to answer questions by the visitors of a museum. The museum is on Anatolian civilizations. The engineer points out that the robot is programmed to understand only i) *Hittite and Phrygian dialects* and ii) *does not understand vocabulary that refers to ancient Urartu civilizations* (Eastern Anatolian). These point out to assumptions on speech recognition capability and the technical vocabulary database of the robot.

The design engineer need not completely understand either the various Anatolia dialects or the kind of ancient civilizations but he is aware of them.

A LOOK AT THE GRADUATE ATTRIBUTES THROUGH KEYWORDS

Renewed emphasis is on:

**DIGITIZATION, AUTOMATION, SUSTAINABILITY,
CONTINUOUS DEVELOPMENT, CREATIVITY, BROADER VIEW, DIVERSITY/INCLUSION**

RESEARCH, CREATIVITY, CRITICAL THINKING

WA2: Identify, formulate, **research** literature

WA4: Investigate ... problems using **research** methods including **research-based** knowledge The "research" here consist of learning how to find out what is already known about a particular problem (*anything more than this would be unrealistic for a four-year curriculum*).

WA3: Design **creative** solutions

WA5: **Create** ... techniques, resources, ... and IT tools Student must be confronted with problems that need selection of a tool, including some that necessitate the creation of a new tool. «Creation» need not be comprehensive, definitely not a new software.

WA11: ... ability for ... **critical thinking** Critical thinking can be understood as an "active, logical, and questioning process of accepting facts or beliefs."

COMPUTING , REMOTE SETTINGS, EMERGING TECHNOLOGIES

WA1: Apply knowledge of ... **computing** and engineering **fundamentals**

Knowledge of “computing fundamentals” are knowledge of e.g. algorithms, numerical analysis, basic optimization approaches (*not those required in WA5 as computing tool usage!*).

WA8: Function effectively ... in ... **remote** and distributed **settings** May require that a “distance team meeting” is observed and its effectiveness is evaluated.

WA11: ... adaptability to new and **emerging technologies** ... Prominent emerging technologies are in the realm of information theory and artificial intelligence but the main characteristic of many others is that they are interdisciplinary, at the boundaries of traditional ones.

ETHICS, DIVERSITY & INCLUSION

WA7: ... commit to professional **ethics** and norms ... Demonstrate an understanding of the need for **diversity and inclusion**

WA9: Communicate effectively and **inclusively** ...

WA8: Function effectively ... as a member or leader in **diverse and inclusive teams**

- 1) If a devoted course to ethics is not feasible, then plan-B may be to design, as parts of some appropriate courses, a number of case studies.
- 2) Learning differences, physical handicaps, cultural choices are all parts of D&I considerations.
- 3) D&I as an «attitude» is very much a part of ethics.

DESIGN

WA3: Design creative solutions for complex engineering problems and **design** systems, components or processes A design has the features that

- i) it is *incompletely defined, not amenable to a deductive resolution, and requires an innovative or creative approach*
- ii) *it admits differing and equally acceptable solutions* may be considered.

WA4: ... design ... experiments

The word "design" necessitates that a student (or a group of students) devises which experiment would be suitable with their own initiative (without guidance).

SUSTAINABILITY

WA2: Investigate ... with holistic considerations for **sustainable development**

WA3: Design ... solutions ... with appropriate consideration for **public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations**

WA6: ...evaluate **sustainable development impacts** ...

- 1) The sustainable development outcomes must be considered at problem definition, analysis, design, and evaluation stages, **all**.
- 2) Students must be made aware of what these considerations are and learn how to identify those that are relevant to a particular problem.
- 3) The observance of these aspects in each major student work on analysis and design may be sufficient (*although, in some disciplines, a full course for a particular aspect may be necessary*).



SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

1 NO POVERTY 	2 ZERO HUNGER 	3 GOOD HEALTH AND WELL-BEING 	4 QUALITY EDUCATION 	5 GENDER EQUALITY 	6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY 	8 DECENT WORK AND ECONOMIC GROWTH 	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 	10 REDUCED INEQUALITIES 	11 SUSTAINABLE CITIES AND COMMUNITIES 	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION 	14 LIFE BELOW WATER 	15 LIFE ON LAND 	16 PEACE, JUSTICE AND STRONG INSTITUTIONS 	17 PARTNERSHIPS FOR THE GOALS 	 SUSTAINABLE DEVELOPMENT GOALS

UN SDG: ALL ARE RELEVANT

- 1. NO POVERTY:** In India, more than 100 million low-income users have access to mobile phones that cost less than US\$25.
- 2. ZERO HUNGER:** Communications technology for weather monitoring, forecasting and disaster
- 3. GOOD HEALTH:** A rubber-based leg prosthetic enables thousands of people with disabilities to become more mobile
- 10. REDUCED INEQUALITIES:** The 'Chotukool' fridge, which costs US\$69 and keeps food cool, enable women to spend more time on economic activities

BREAK (10 minutes)

A CLOSER LOOK AT ATTRIBUTES

IEA respects the uniqueness of every engineering program, many of which display better practices than those suggested in what follows.

The expressed views and suggestions on how to demonstrate and how to evaluate the graduate attributes are personal.

Differentiating Characteristic	... for Washington Accord 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 solutions to complex engineering problems	<ol style="list-style-type: none"> 1) Each component of "knowledge" would require inclusion of a number of full semester-courses in the 4-5 year curriculum (usually, many in the first two years). 2) GAPC only indicates what a curriculum need contain via Table 3, Knowledge and Attitude Profile. 3) Some Engineering Accreditation Criteria (EAC) stipulate that there must be 30 semester-credit hours (approximately corresponding to a total of 10 courses) to satisfy mathematics and natural sciences together. 4) Similarly, some EAC require 45 semester-credit hours of courses to satisfy computing and engineering fundamentals knowledge requirement. 5) <u>The new addition "computing" here does not mean "Tool Usage."</u>

Differentiating Characteristic	... for Washington Accord Graduate	
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)	<ol style="list-style-type: none"> 1) Qualitative statements of problems are usually already there. The students should learn how to go from there to a quantitative (mathematical, model-based, physical, computational) description. 2) Students should learn how to judge the validity of assumptions made at the formulation and analysis stages. 3) The sustainable development outcomes must be considered also at problem definition and problem analysis stages: <ul style="list-style-type: none"> • make the students aware of what these considerations are • make sure they learn how to identify those that are relevant to a particular problem under study • re-design suitable motivational as well as application examples given throughout the curriculum.

COMPLEX vs WELL-DEFINED: MAKE A WIRE TURN

Engineering Problem: Make a wire excited by voltage turn.

Solution: Wring (twist) a copper wire into a loop and place it in a magnetic field after applying voltage at its ends.

Complex Engineering Problem: Why does a wire excited by voltage turns when placed in a magnetic field?

Solution: Explain via Faraday's or Lorentz or Maxwell's laws. This requires a knowledge of *vector fields* (Mathematics), *magnetic flux* (Physics), and *partial differential equations* (Mathematics), all of which are available in a third year electromagnetics book.

Both are engineering problems but require different knowledge and skills, neither superior to other.

Differentiating Characteristic	... for Washington Accord 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)	<ol style="list-style-type: none"> 1) A solution is a design solution if <ol style="list-style-type: none"> i) its problem is <i>incompletely defined, not amenable to a deductive resolution, and requires an innovative or creative approach.</i> ii) its problem potentially <i>admits differing and equally acceptable solutions.</i> 2) Some HEI's present a list of "appropriate considerations" as an integral part of the capstone design project. In order to guarantee that the solution takes a most relevant subset into account. It is possible to include a reference to UN-SDG in this list or to form the list based on UN-SDG. 3) The "creative solutions" can perhaps be encouraged by bringing forth (extra credit, reward, honorable mention, etc.) unique solutions in student assignments.

Differentiating Characteristic	... for Washington Accord Graduate	
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)	<ol style="list-style-type: none"> 1) The "research methods" here consist of learning how to find out what is already known about a particular problem 2) The teaching of "design of experiments" is obviously dependent on the engineering discipline: "writing a code to detect sources of bugs in a software" in computer engineering, "measuring elasticity" in mechanical engineering, "determining channel capacity" in electrical engineering, and so on. The word "design" necessitates that a student (or a group of students) devises which experiment would be suitable without guidance. 3) Design of experiments, analysis and interpretation of data, synthesis of information are all methods of investigation that can be implemented as <i>parts</i> of suitable courses, not necessarily in separate courses.

Differentiating Characteristic	... for Washington Accord Graduate	<ol style="list-style-type: none"> 1) The attribute is to be able to select and apply the appropriate tool from among those that the recent (modern) technology offers; and, to be able to create one when none of the existing tools answer the present need. 2) The implementation not only requires to confront the student with problems that need selection of a tool but also with some that necessitate the creation of a new tool. 3) Do not expect a creation that is comprehensive (a new software!); adding a feature to an existing software, synthesis of two separately available tools, an alteration of an existing model (from linear to nonlinear, from time-invariant to slowly time-varying, from polynomial to exponential etc.) would be examples that can be introduced in a four-year curriculum.
Tool Usage: Level of understanding of the appropriateness of technologies and 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)	

Differentiating Characteristic	... for Washington Accord Graduate	
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)	<ol style="list-style-type: none"> 1) This attribute can partly be acquired by its implementation in the capstone design experience. 2) An awareness of social sciences is obviously important to the attainment of this attribute. Offered social sciences elective courses must be relevant to the discipline. Sociology and Psychology in Computer and Industrial Engineering; Economy in all traditional engineering disciplines, and so on. 3) In some disciplines, a full 3-semester-credit course for a particular aspect may be feasible (e.g. health and safety). Otherwise, the observance of sustainable development issues in every major student work on analysis and design may work.

ETHICS: A POSSIBLE CLASSIFICATION

Rules that Regulate Human-to-Human and Human-to-Institution Relationships

Laws: Lawful (Legal) vs Unlawful (Illegal)

Obey laws

Norms: Normal (Appropriate) vs Abnormal (Inappropriate)

Listen while the other is talking, Unplug while repairing (even if very low power), Dress appropriate to the occasion

Ethics: Right vs Wrong

Be accountable, Keep promise, Do not endanger anything/anybody

Morals: Good (Virtue) vs Bad (Vice)

Help the needy, Be just

Differentiating Characteristic	... for Washington Accord Graduate	This row is about understanding and practicing ethics. The additions are detailing what aspects ethics encompasses. D&I, as an "attitude" is very much a part of ethics.
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)	D&I, as an "attitude" is very much a part of ethics. Team work is an instance where D&I is especially important. Communication is another. 1) In order to demonstrate D&I as an "attitude," one may design one or two case studies on "workplace ethics problem on non-discrimination." 2) Forming any lab or project team among students randomly , as a principle, may contribute to D&I. 3) Professional ethics is more than "not to cheat on the specs of a product," it is more embracing and includes all aspects indicated in this attribute.

Differentiating Characteristic	... for Washington Accord 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)	<ol style="list-style-type: none"> 1) The teamwork attribute, especially multidisciplinary one, is a major challenge of implementation in any engineering discipline, not only to realize but even to sustain after having started. This is, however, an attribute almost every employer of engineers puts at the top of the "must be" list. 2) "inclusive" draws attention that teams must learn to function with individuals of different backgrounds and different levels of learnings, etc. One implementation in the curriculum is to form any lab or project team among students randomly, as a principle. 3) The "remote and distributed settings" component will continue to be the primary setting for any group to work together. An implementation example may be to require that a "distance team meeting" is observed and its effectiveness is evaluated. 4) If most major student projects are done in groups, then a measurement of individual contributions becomes necessary.

Differentiating Characteristic	... for Washington Accord Graduate	
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.	<ol style="list-style-type: none"> 1) This attribute has many important components. one can think of. The choice is shaped by specific scenarios in mind. The present priorities are on "reports and documentation" and "language and learning differences." 2) The implementation would require that every student not only writes a comprehensive report, makes a formal presentation, and faces a diverse audience at least once during the education period but that all these activities are evaluated by instructor(s) using suitable performance criteria, with feedback to the students, and with "repeat" a viable option.

Differentiating Characteristic	... for Washington Accord Graduate	
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 in multidisciplinary environments.	<ol style="list-style-type: none"> 1) Many EACs implement this attribute via a must or elective course, although this is neither sufficient nor necessary. 2) Knowledge of systems engineering and/or project management tools and processes to the planning and execution of project work are required. 3) The correct implementation strongly depends on the engineering discipline as well as the program educational objectives. 4) There are examples where the capstone design experience is implemented as a major collaborative project that requires management and has economic and financial dimensions.

Differentiating Characteristic	... for Washington Accord Graduate	1) This row concerns both continuity and aspects (types) of learning.
Lifelong learning: Duration and manner	WA11: Recognize the need for, and have the preparation and ability 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)	2) An example implementation for (i) and (ii): Students attend (and can submit its proof) to one or two lessons or seminars in which they listen to real experiences of adaptability and change management of a professional engineer. 3) A student's engagement with a professional and intellectual community may be a further demonstration of (i) and (ii). 4) Critical thinking can be taught and learned. Consider adding an item among the evaluation criteria of any major student work: Has the student applied a questioning and logical process while making assumptions and decisions?

SOURCES

- **IEA GAPC** (<https://www.ieagrements.org/assets/Uploads/Documents/IEA-Graduate-Attributes-and-Professional-Competencies-2021.1-Sept-2021.pdf>)
- **UN SDG** (<https://www.undp.org/>)
- **UNESCO Engineering Report, March 2021** (<http://worldengineeringday.net/wp-content/uploads/2021/03/UNESCO-Engineering-Report-Engineering-for-Sustainable-Development-EN.pdf>)
- **ENZ: Accreditation Standards** (https://d2rjvl4n5h2b61.cloudfront.net/media/documents/ACC_02_Accreditation_Criteria_V3.1_20201030.pdf)
- **UK-Spec third edition.pdf** (<https://www.engc.org.uk/standards-guidance/standards/uk-spec/>)
- **ACED Engineering 2035, 2019** (<https://www.aced.edu.au/index.php/examples>)

Thank You

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