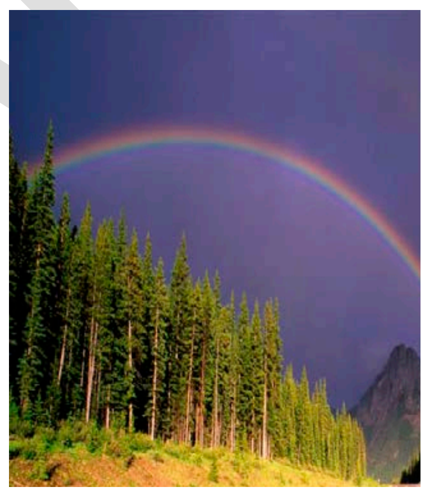
Engineering Instruction and Accreditation



Consultation on Advances in Accreditation

March 2016

consultation@engineerscanada.ca

REQUEST FOR INPUT FROM THE PROFESSION

In September 2015, the Engineers Canada Board established the Engineering Instruction and Accreditation Consultation Group composed of members from four stakeholder groups: Engineers Canada Executive Committee, Engineering Regulators, National Council of Deans of Engineering and Applied Science and the Accreditation Board. The Group's mandate was to make recommendations to the Board regarding improvements to the accreditation system.

On February 24, 2016 the Board received the Consultation Group's report. One recommendation was that the Accreditation Board further develop the consultation document, in close cooperation with the National Council of Deans of Engineering and Applied Science. The recommendation was followed and the outcome is this document.

This document is intended to launch the consultation with stakeholders. Please submit your comments to consultation@engineerscanada.ca .

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EXECUTIVE SUMMARY

Since 1965, Engineers Canada's Accreditation Board has accredited Canadian undergraduate engineering programs that meet or exceed educational standards acceptable for professional engineering registration in Canada. The Accreditation Board's work supports consistency among regulators' regulatory standards and practices to protect and serve the public interest.

Accreditation applies to undergraduate engineering programs in Canada. It is a voluntary process, undertaken at the request of a higher education institution (HEI). A program requesting an accreditation visit completes a detailed self-assessment. A team of senior engineers visits the institution to collect and verify information about the program. The visit team is assembled under the direction of a current or recent Accreditation Board member. When the visit team reviews the quality and quantity of the program's curriculum content it seeks to ensure the curriculum meets the minimum criteria. The team then reports its findings to the Accreditation Board.

The current method used to analyze the quantitative data reflecting the content of the engineering programs was established in 1996 as the result of the work of the CEAB/NCDEAS Task Force on Curriculum Content. The curriculum content criteria began to be expressed in "Accreditation Units" rather than "years".

It is a requirement for accreditation that the curriculum content criteria be met by all students. This aspect of the engineering accreditation system provides assurance to the regulators that graduates meet the academic requirements for licensure without requiring additional technical examinations.

In 2008, after several years of study and consultation, outcomes assessment criteria (graduate attributes and continual improvement) were adopted by the Engineers Canada Board as an additional measure that applies to programs overall. There is no requirement that all students must meet graduate attribute criteria. Likewise, continual improvement criteria are met by programs, not by students. Adding these elements to existing criteria brought Canada in line with all other signatories of the Washington Accord, the largest international mutual recognition agreement dealing with exclusively with engineering education.

When the decision was made to add outcomes assessment to the existing criteria, discussion began on ways to address the additional workload represented by outcomes assessment. Attempts at developing a suitable alternative have not resulted in identifying an alternative method. In addition, Deans have in the last two years been raising issues regarding the constraints put upon educational innovation by the current system. Many Deans feel that there is insufficient flexibility in the current system. Others recognize that the flexibility exists, but wish to see additional clarity in the wording of the criteria.

Concerns raised about accreditation resulted in the Engineers Canada Board establishing the *Consultation Group on Engineering Education and Accreditation*. The Consultation Group consulted with stakeholders by holding two webinars in December 2015 and January 2016. The Consultation Group's report was presented to the Engineers Canada Board in February 2016. That report identified “flexibility” as a short-term issue requiring immediate action and “workload” as a long-term issue that requires a longer timeline to address.

The current curriculum proposal is considered as the next logical step. This proposal seeks to align with curriculum assessment alternatives looked at in the past and a move to less reliance on curriculum content assessment into the future, now that additional measures of engineering program quality have been added to the criteria.

The NCDEAS and Accreditation Board representatives on the Consultation Group support removing the criterion for overall program curriculum content on the proviso that engineering programs continue to be at least 4 years long. The core engineering curriculum requirements and the requirement for licensure of faculty remain unchanged. This approach is not necessarily endorsed by all Deans and by all Accreditation Board members; however it is supported by the majority in each group. Some regulators remain uncertain that this approach will preserve the quality of the current engineering degree. Further consultation and communication is required.

The Accreditation Board has also performed an overall review of the criteria, and wishes to propose a number of changes. These changes are more of a “housekeeping” nature. Consolidated proposed changes are attached as Appendix “E”.

BACKGROUND

In 1965, Engineers Canada established the Accreditation Board, a board of specialists tasked with accrediting Canadian undergraduate engineering programs that meet or exceed educational standards acceptable for professional engineering registration in Canada.

Accreditation is important for several reasons. It promotes the mobility of Canadian engineering graduates. It helps regulators identify which applicants have the right education to begin the journey towards licensure. It provides assurances to the public as to which engineering education programs meet the regulators' high education standards. It helps graduates demonstrate they have met internationally recognized standards.

An accreditation review consists of assessing both qualitative and quantitative aspects of an engineering education program. In order to provide assurance that all graduates meet specific curriculum content criteria, programs are measured in a quantitative manner. The education must also meet quality criteria. In 2008, after several years of study and consultation, outcomes assessment criteria (graduate attributes and continual improvement) were adopted by the Engineers Canada board[1]. This became an additional measure that applies to programs overall rather than to individual students. Adding these elements brought Canada in line with all other signatories of the Washington Accord, the largest international mutual recognition agreement dealing with exclusively with engineering education. Washington Accord signatories are required to show substantial equivalency with the Accord's Graduate Attribute exemplar. Signatories also have minimum credit requirements linked to notional hours of learning.

The inclusion of graduate attributes and continual improvement criteria came with both a six year implementation period for engineering programs and a commitment from the AB to re-assess the current input measurement methodologies. Adding outcomes assessment increased the workload of programs[2] undergoing an accreditation assessment, and of accreditation visit teams. The intent was to

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[1] Major activities and milestones

[2] In jurisdictions where there are provincial quality assurance requirements, there is a possibility that much of the work done in preparation for an accreditation visit can also be used to demonstrate compliance with provincial requirements

find ways of simplifying the curriculum content measurement methodology and eventually reducing reliance on the detailed analysis of inputs (curriculum measurement) as confidence grew in the outcomes assessment results.

Since the inclusion of graduate attributes and continual improvement criteria, there have been attempts to develop a simpler method of measuring curriculum content[3] to balance the additional workload. In 2012 an Accreditation Board task group on *Balancing Inputs and Outputs* presented two alternatives. One of these proposed methodologies uses "hours of instruction". This is equivalent to the academic unit (AU), but with more freedom left to the institution to choose the exact calculation method. The other proposed methodology expresses components in percentage terms, observing that the test for sufficiency of the curriculum is the satisfactory development of those attributes linked to it. Due to lack of consensus, neither of these approaches was adopted.

Editorial Note: somewhere we need to explain how the current alternative is the appropriate next step and how it fits into a longer term plan to reduce the AU reliance methodology Input from NCDEAS would be helpful here (to help explain how this is an appropriate next step)

Accreditation Board members have also been working to find ways to make the accreditation process less onerous in terms of workload on programs and on accreditation volunteers. Every visit cycle the self-assessment Questionnaire is reviewed to remove any redundancies. The number of reports requested is assessed and any unessential reports are removed. Instructions are clarified or added as required. However, as accreditation typically spans a six year cycle, improvements made one year may not be recognized by an institution until up to five years later.

SHORT AND LONG-TERM ISSUES THAT HAVE BEEN RAISED REGARDING ACCREDITATION

Several issues have been raised by National Council of Deans of Engineering and Applied Science with regards to the curriculum content measurement methodology and workloads. Examples of issues include: inadequate flexibility for educational innovation and alternative forms of program delivery (such as active independent learning, experiential learning, project based learning, MOOCs, etc.); insufficient ability to adequately complement technology-focused studies with other studies (e.g., management, social sciences, entrepreneurship, research, etc.); an over-constrained dual model of input / output based assessment that hinders innovation; and excessive workloads for all involved in preparing for and conducting accreditation visits.

It should be noted that some members of the stakeholder groups feel confident that the criteria are sufficiently flexible to allow for innovation. However, not all stakeholders have the same level of expertise regarding the criteria and interpretive statements.

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[3] Report

Accreditation Board members have been working to find ways to make the accreditation process less onerous on programs and on accreditation volunteers. Both the Deans and the Accreditation Board are faced with significant workload issues that need to be addressed.

IMPLEMENTATION OF GRADUATE ATTRIBUTES & CONTINUAL IMPROVEMENT

Graduate attribute and continual improvement criteria were adopted by the Engineers Canada Board in 2008. A six year implementation period was provided for programs to become ready to comply with these additional measures. During the six-year implementation period, programs received ongoing feedback on their preparedness to comply as part of the accreditation visit process (through the visiting team reports and the accreditation decision letters). From 2008 to 2014, accreditation decisions were not impacted by compliance (on non-compliance) with graduate attributes and continual improvement criteria.

At about the same time as concerns were raised about the accreditation system, 57 out of a total of 279 programs received accreditation decisions that included decisions on compliance with accreditation criteria. The decisions, broken into categories, show that programs demonstrate good compliance overall. Note that “comments” are used to clarify Accreditation Board expectations and have no impact on accreditation decisions:

June 2015 decision summary of 57 program visits:

Criterion	Name	Deficiencies	Weaknesses	Concerns	Comments	Total	Notes
3.1	Graduate Attributes	3	5	1	0	9	Few issues, overall good compliance
3.2	Continual Improvement	3	10	45	53	111	Comments and concerns mostly formative feedback
3.3	Students	0	7	4	0	11	Few issues, overall good compliance
3.4	Curriculum	2	12	1	0	15	Few issues, overall good compliance
3.5	Program Environment	13	11	17	0	41	Deficiencies mostly related to licensure criterion 3.5.5
3.6	Procedures and Processes	1	1	0	0	2	Few issues, overall good compliance

It is expected that by 2020, all current programs will have been assessed for compliance with the graduate attributes and continual improvement criterion.

TOOLS DEVELOPPED TO ASSIST IN THE ASSESSMENT OF GRADUATE ATTRIBUTES AND CONTINUAL IMPROVEMENT

Tools developed by the Accreditation Board to assist visiting teams are posted on the Engineers Canada website, accreditation page on the "under development" section. This allows program officials to see the matrices and guidelines expected to be used by visiting team members.

DECISION OF THE ENGINEERS CANADA BOARD TO ESTABLISH A CONSULTATION GROUP

The Accreditation Board Chair and the Chair of the National Council of Deans of Engineering and Applied Science are advisors to the Engineers Canada Board. Both attend Engineers Canada Board meetings and provide updates on current issues. In December 2014, the Chair of the NCDEAS, at the request of the Engineers Canada President, outlined concerns about accreditation.

In May 2015, the President of Engineers Canada convened a workshop to discuss accreditation concerns. The initial report on the outcomes of that workshop included that the next steps for the Accreditation Board were to recommend changes to the accreditation system, a process for ongoing face-to-face consultation, and an achievable but expeditious schedule for implementing change. An approach to change and next steps should be in place before the end of 2015.

At the September 30, 2015, Engineers Canada Board meeting, the Consultation Group was established. The group is to make recommendations to the Engineers Canada Board at its February 2016 meeting. The composition of the Consultation Group is follows:

Stakeholder Group	Name
Engineers Canada Board	Larry Staples (chair) Zaki Ghavitian
Accreditation Board	Gérard Lachiver Wayne McQuarrie
National Council of Deans of Engineering & Applied Science	Greg Naterer Ishwar Puri
Regulators	Grant Koropatnick Gerard McDonald

STATUS OF THE CONSULTATION PROCESS

Initial activities of the Consultation Group: Original Consultation Document

The Consultation Group received and circulated a Consultation Document representing the joint perspective of the majority of AB and NCDEAS (full document available on the consultation page of the Engineers Canada website).

The document included:

- Short term issues framed: lack of flexibility for educational innovation, and unsustainable workload due to dual assessment of inputs and outcomes
- Long term issues framed: alternate methodology for counting curriculum content (in combination with outcomes measures), and streamlining of steady-state accreditation workload
- Principles to address short term issues
- Proposed changes to section 3.4.6 of the Accreditation Manual and implementation plan to address the short term issues
- Principles to address long term issues

Consultation Webinars:

The Consultation Group held two webinars, each with approximately 70 attendees from across-Canada, in early December and early January (background material for the webinars available on the consultation page)

The Consultation Group report of February 24, 2016 notes that:

- There is very high interest in this topic; these are the largest webinars hosted by Engineers Canada.
- The main message from attendees at the first webinar was concern that the proposed changes would result in "watering down" of engineering programs and "variable quality" of graduates
- Additional information was provided before the second webinar, including explicit assurances from the AB and the NCDEAS that "watering down" and "variable quality" would not occur
- During the second webinar, it was confirmed that the student "minimum path" was unaffected by the proposed changes (i.e. admissions officials could continue to confidently accept applicants from accredited universities)
- The main message from attendees at the second webinar was, notwithstanding the additional information and assurances, their concerns were unabated
- In addition to comments during the webinars, several e-mails and letters were received. Some e-mails/letters posed questions or offered suggestions; some formally stated that admissions officials did not support the proposal in its current form.

Consultation Group Initial Observations

- The Consultation Document is a significant step forward in what has become a protracted discussion; it represents a meeting of the minds of AB and NCDEAS

- The main message from webinar attendees is strong commitment to four-year programs with rigorous content. This is an unequivocal statement of the "desired accreditation outcome" by the end-users of EC's accreditation services.
- "Big picture" concepts were interjected into the discussion at several points (e.g. program duration of five year versus four years; the need for more technical depth versus more personal rounding of students)
- The present consultation process has been less than satisfactory for all concerned
  - Partially due to short timeline, imprecise framing of the problem and insufficient detail in the proposed changes
  - Partially due to "big picture" concerns about engineering education and the overall accreditation process spilling down to magnify concerns over a relatively small proposed change
  - The present audience is too large to accommodate effective dialogue

Consultation Group Conclusions

- At present, the proposed changes continue to raise questions and concerns
- Stalling at the status quo is not an option. The workload issues are real and must be addressed as rapidly as possible, to the extent possible through non-policy changes to AB procedures around documentation and visit logistics, and through development by EC (CEO and team) of tools and staff support.
- Other pinch-points identified by NCDEAS, e.g. flexibility for educational innovation, are valid and should be addressed in a timely manner.
- Changes to the accreditation process should follow a defined consultation and decision protocol led by the AB in close co-operation with the NCDEAS – with explicit recognition that the strongly-expressed "desired accreditation outcome" will be respected.
- A clear vision of the future of accreditation is needed, so that "short term solutions" are steps along the path and are seen by all stakeholders as progress toward the ultimate goal

INTERIM STEP: MAIN FOCUS OF THIS CONSULTATION

Any future changes to Accreditation criteria must comply with the following overarching principles:

- the overall quality of the engineering degree will remain unchanged or improve
- engineering programs will continue to be 4 years, or equivalent
- the core engineering curriculum requirements (math, natural science, engineering science, engineering design, complementary studies) and the requirement for licensure of certain faculty will remain unchanged.

The proposed changes to the criteria that are the main focus of the consultation are:

3.4.2	Minimum curriculum components: An engineering program must include the following minima ~~minimum for the entire curriculum and~~ for each of its components. ~~* The entire program must include a minimum of 1,950 AU~~ Engineering science and engineering design: Minimum 900 AU *Which includes a minimum 225 AU in each of Engineering science and Engineering design* Mathematics and natural sciences: Minimum 420 AU *Which includes a minimum 195 AU in each of Mathematics and Natural sciences.* Complementary Studies: Minimum 225 AU Laboratory experience and safety procedures instruction	Change to accommodate new definition of total program load
3.4.5	A minimum of 225 AU of complementary studies: Complementary studies include humanities, social sciences, arts, management, engineering economics and communications that complement the technical content of the curriculum.	Minor editorial change
3.4.5.1	While considerable latitude is provided in the choice of suitable content for the complementary studies component of the curriculum, some areas of study are essential in the education of an engineer. Accordingly, the curriculum must include studies in the following: a. Subject matter that deals with central issues, methodologies, and thought processes of the humanities and social sciences b. Oral and written communications c. Professionalism, ethics, equity and law d. The impact of technology on society e. Health and safety f. Sustainable development and environmental stewardship g. Engineering economics and project management	Minor editorial changes to better align with terminology used in graduate attributes
3.4.6	The program must have a minimum of ~~1,950 Accreditation units~~ four years of full-time (or equivalent) appropriate content ~~that are~~ at a university level.	New text
	To evaluate this criterion, the Accreditation Board will rely on the *Interpretive statement on minimum program content,* which is attached as an appendix to this document.	Details in interpretive statement. Total institutional credits not to be less than currently accredited program(s)

The Accreditation Board has also performed an overall review of the criteria, and wishes to propose a number of changes. These changes are more of a “housekeeping” nature. Consolidated proposed changes are attached as Appendix “E”.

LONGER TERM VISION

The Consultation Group terms of reference provides a mandate to consult on the proposed changes to criteria as described earlier in this document. Longer term issues out outside the mandate of the Consultation Group. However, the motion adopted above by the Engineers Canada board includes both the Consultation Group recommendations (items a), b) and c) above) as per the Consultation Group terms of reference AND the suggestions (items d) onwards). The suggestions are beyond the terms of reference. It appears that the Board is supportive of both the recommendations and the suggestions.

Deans and the Accreditation Board are committed to working together towards resolving the long-term issues for the good of the profession. The Accreditation Board will continue to identify, in consultation with the Deans, measures to address both programs and Accreditation Board workload issues. The Accreditation Board has developed an initial outline to make progress towards resolving these issues. Please see Appendix C for the initial outline.

A set of Questions and Answers are provided in Appendix F. If you have additional questions regarding this consultation, please forward them to consultation@engineerscanada.ca.

TABLE A:

The following is a summary of major milestones and activities related to the inclusion of outcomes assessment criteria

Activity	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
AB studies outcomes based assessment in the ABET system	■												
AB representatives observe several ABET visits in 2003/2004	■	■											
Workshop: AB milestones, other accreditation systems, draft revised criteria			■										
Workshop for further progress on the amended criteria				■									
Proposed revisions approved for consultation by AB					■								
Formal consultation with stakeholders					■								
Final revisions approved by AB, then Engineers Canada. Publication						■							
Transition period							■	■	■	■	■	■	
Workshops on outcomes assessment criteria for programs and volunteers							■	■	■	■	■	■	■
Decisions taken in respect of “new” criteria													■

APPENDIX A – Motion adopted by Engineers Canada February 24, 2016

The Consultation Group delivered its report at the February 24, 2016 Engineers Canada Board meeting. The motion adopted by the Board is as follows:

Amended motion to accept the following recommendations from the consultation group:

a) THAT The AB further develop the Consultation Document, in close cooperation with NCDEAS – revised document to be finalized by July, 2016 for ratification, or decision if necessary, by the EC Board in the fall of 2016. In particular:

   i. Develop a final draft of the Interpretive Statement;

   ii. Incorporate suggestions identified in motion b) into a revised Consultation Document and/or Interpretive Statement;

   iii. Expand the Consultation Document by adding narrative and analysis on up to two alternatives identified in motion b);

   iv. For each approach outlined in the revised Consultation Document, include commentary on the most likely impact on program quality and the "desired accreditation outcome", plus commentary on checks and balances which preclude unmanaged negative impacts;

   v. Recommend the preferred approach.

b) THAT the AB consider all suggestions made during the current consultation. In particular:

   i. Identify suggestions which improve the approach outlined in the Consultation Document;

   ii. Identify and explore suggestions which provide potentially better alternate approaches;

   iii. Provide brief rationale for suggestions not pursued;

   iv. Communicate above to workshop attendees and other stakeholders.

c) THAT stewardship of further progress on the Consultation Document revert to normal governance processes of EC.

   i. AB has responsibility and accountability for developing this policy alternative, in close cooperation with NCDEAS

   ii. Regulators and other stakeholders should be consulted with respect to the impact on "desired accreditation outcome", but details of accreditation procedures should be left to AB and NCDEAS;

   iii. The EC Board will ratify, modify or reject the recommended approach by normal voting procedures;

iv. The Consultation Group will act as a sounding board, upon the request of the AB or the National Council of Deans of Engineering and Applied Science, until the revised Consultation Document is finalized in July, then stand down.

d) THAT the AB, the NCDEAS and Regulators consider working together to expand upon and refine the "desired accreditation outcome" (i.e. graduates who reliably meet the standards of admission). Regular joint discussions could become a forum in which "big picture" issues are put on the table and ramifications explored regarding accreditation, education and registration.

e) THAT the AB consider giving heightened attention to transparency, effective stakeholder communication, and routine consideration of concerns and suggestions received in order to proactively manage the significant changes coming to the accreditation system.

f) THAT the EC Board maintain higher awareness of this challenge, particularly the pace of progress and the overall "system cost" (HEI dollars, EC dollars, HEI staff time, AB volunteer time, EC staff time);

g) THAT AB expeditiously develop policies and procedures to reduce, in the short term, the present workload to sustainable levels, in the joint judgement of AB and NCDEAS; and further, consider requesting the CEO to assist with staff resources.

h) THAT the CEO accelerate development of organizational supports for accreditation processes (e.g. visitor training, electronic document handling, web-based workspaces, logistics for and coordination of visits).

i) THAT the CEO provide change management assistance to AB, either staff expertise if available or consultant expertise.

j) THAT AB, in close cooperation with NCDEAS, expeditiously develop a white paper outlining the options for the long-term solution, respective pros and cons, and recommended principles for evaluating the options; and further, consider requesting the CEO to assist with staff resources.

APPENDIX B - Report of the Consultation Group on Engineering Instruction and Accreditation

Submitted to: Engineers Canada Board

Date: February 24, 2016

Overview

The Consultation Group was established at the September 2015 EC Board meeting, to finalize the Consultation Document, receive comments from stakeholders, review draft recommendations with stakeholders, and make recommendations to the EC Board in February 2016.

Discussions over the past weeks have reinforced the view of the Consultation Group that the accreditation system has served the profession very well, and that it continues to be a robust common activity on behalf of the Regulators. There is remarkable interest in, commitment to, and investment of volunteer hours into conducting and improving the accreditation system. Simultaneously, there is need for change for both external reasons (keeping pace with international best practices of our Washington Accord colleagues) and internal reasons (process efficiency and flexibility).

The conversation about change has made good progress since September. The Consultation Document represents clarity and improved understanding between AB and NCDEAS. The "clients" of the accreditation system, the Regulators, have stated unequivocally that changes must in no way diminish the quality of engineering graduates applying for registration – and the AB and NCDEAS have unequivocally stated their commitment to that end. Specific concerns have been identified and will be addressed; suggestions have been made and will be assessed.

While the Consultation Group itself reached consensus that the changes proposed are workable and can be implemented without diminishing quality, stakeholder feedback in the webinars continue to raise questions and concerns. It is therefore premature to recommend acceptance of the changes in February. Additional time to respond to questions and concerns, while being open to modifying the recommendations to accommodate good ideas, will yield a more stable decision in the long run. This is the basis of the recommendations below. It is also recommended that the ongoing conversation about change revert to the normal governance processes of EC. The Consultation Group has confidence in the AB and the NCDEAS to lead Engineers Canada and the Regulators into the future.

The Consultation Group is also of the view that pent-up "big picture" questions and concerns about the future of accreditation have added a layer of complexity to discussion of the relatively small changes proposed in the Consultation Document. The Consultation Group has ventured beyond the Terms of Reference to offer a number of "big picture" suggestions, below. It is important to both expeditiously address the workload issues and to establish a vision for the future of accreditation as context for changes proposed from time to time. More effort needs to be invested in change management, and more staff support may be needed to support the operational elements of AB activities plus ongoing dialogue with stakeholders.

Consultation Document

The Consultation Group received and circulated a Consultation Document which represents the joint perspective of AB and NCDEAS (full document available on the consultation page of the Engineers Canada website)

- Short term issues framed: lack of flexibility for educational innovation, and unsustainable workload due to dual assessment of inputs and outcomes
- Long term issues framed: alternate methodology for counting curriculum content (in combination with outcomes measures), and streamlining of steady-state accreditation workload
- Principles to address short term issues
- Proposed changes to section 3.4.6 of the Accreditation Manual and implementation plan to address the short term issues
- Principles to address long term issues

Webinars

- The Consultation Group held two cross-Canada webinars, each with approximately 70 attendees, in early December and early January (background material for the webinars available on the consultation page)
- There is very high interest in this topic; these are the largest webinars hosted by Engineers Canada
- The main message from attendees at the first webinar was strong concern that the proposed changes would result in “watering down” of engineering programs and “variable quality” of graduates
- Additional information was provided before the second webinar, including explicit assurances from the AB and the NCDEAS that “watering down” and “variable quality” would not occur
- During the second webinar, it was confirmed that the student “minimum path” was unaffected by the proposed changes (i.e. admissions officials could continue to confidently accept applicants from accredited universities)
- The main message from attendees at the second webinar was, notwithstanding the additional information and assurances, their concerns were unabated
- In addition to comments during the webinars, several e-mails and letters were received. Some e-mails/letters posed questions or offered suggestions; some formally stated that admissions officials did not support the proposal in its current form.

Consultation Group Observations

- The Consultation Document is a significant step forward in what has become a protracted discussion; it represents a meeting of the minds of AB and NCDEAS
- The main message from webinar attendees is strong commitment to four-year programs with rigorous content. This is an unequivocal statement of the “desired accreditation outcome” by the end-users of EC’s accreditation services.
- “Big picture” concepts were interjected into the discussion at several points (e.g. program duration of five year versus four years; the need for more technical depth versus more personal rounding of students)
- The present consultation process has been less than satisfactory for all concerned

- Partially due to short timeline, imprecise framing of the problem and insufficient detail in the proposed changes
- Partially due to “big picture” concerns about engineering education and the overall accreditation process spilling down to magnify concerns over a relatively small proposed change
- The present audience is too large to accommodate effective dialogue

Consultation Group Conclusions

- At present, the proposed changes continue to raise questions and concerns
- Stalling at the status quo is not a good option. The workload issues are real and must be addressed as rapidly as possible, to the extent possible through non-policy changes to AB procedures around documentation and visit logistics, and through development by EC (CEO and team) of tools and staff support.
- Other pinch-points identified by NCDEAS, e.g. flexibility for educational innovation, are valid and should be addressed in a timely manner
- Changes to the accreditation process should follow a defined consultation and decision protocol led by the AB in close co-operation with the NCDEAS – with explicit recognition that the strongly-expressed “desired accreditation outcome” will be respected.
- A clear vision of the future of accreditation is needed, so that “short term solutions” are steps along the path and are seen by all stakeholders as progress toward the ultimate goal

Recommendations (per Terms of Reference)

R-1. That the AB be requested to further develop the Consultation Document, in close cooperation with NCDEAS – revised document to be finalized by July, 2016 for ratification, or decision if necessary, by the EC Board in the fall of 2016. In particular:

a) Develop a final draft of the Interpretive Statement

b) Incorporate suggestions identified in R-2 a) into a revised Consultation Document and/or Interpretive Statement.

c) Expand the Consultation Document by adding narrative and analysis on up to two alternatives identified in R-2 b)

d) For each approach outlined in the revised Consultation Document, include commentary on the most likely impact on program quality and the "desired accreditation outcome", plus commentary on checks and balances which preclude unmanaged negative impacts

e) Recommend the preferred approach

R-2. That the AB be requested to consider all suggestions made during the current consultation. In particular:

a) Identify suggestions which improve the approach outlined in the Consultation Document

b) Identify and explore suggestions which provide potentially better alternate approaches

c) Provide brief rationale for suggestions not pursued

d) Communicate above to workshop attendees and other stakeholders

R-3. That stewardship of further progress on the Consultation Document revert to normal governance processes of EC

a) AB has responsibility and accountability for developing this policy alternative, in close cooperation with NCDEAS

b) Regulators and other stakeholders should be consulted with respect to the impact on "desired accreditation outcome", but details of accreditation procedures should be left to AB and NCDEAS

c) The EC Board will ratify, modify or reject the recommended approach by normal voting procedures

d) The Consultation Group will act as a sounding board, upon the request of the AB or NCDEAS, until the revised Consultation Document is finalized in July, then stand down

Suggestions (beyond Terms of Reference)

The engineering profession in Canada is fortunate to have outstanding expertise on engineering education and accreditation, through AB and NCDEAS

S-1. That the AB, the NCDEAS and Regulators consider working together to expand upon and refine the "desired accreditation outcome" (i.e. graduates who reliably meet the standards of admission). Regular joint discussions could become a forum in which "big picture" issues are put on the table and ramifications explored regarding accreditation, education and registration.

S-2. That the AB consider giving heightened attention to transparency, effective stakeholder communication, and routine consideration of concerns and suggestions received in order to proactively manage the significant changes coming to the accreditation system (see also S-6)

The shift in emphasis from inputs to outcomes in assessing engineering programs should be recognized as a significant change management challenge.

S-3. That the EC Board consider maintaining higher awareness of this challenge, particularly the pace of progress and the overall "system cost" (HEI dollars, EC dollars, HEI staff time, AB volunteer time, EC staff time)

S-4. That the EC Board consider encouraging AB to expeditiously develop policies and procedures to reduce, in the short term, the present workload to sustainable levels, in the joint judgement of AB and NCDEAS; and further, consider requesting the CEO to assist with staff resources.

S-5. That the EC Board consider requesting the CEO to accelerate development of organizational supports for accreditation processes (e.g. visitor training, electronic document handling, web-based workspaces, logistics for and coordination of visits)

S-6. That the EC Board consider requesting the CEO to provide change management assistance to AB, either staff expertise if available or consultant expertise

A clearer vision for the long term future of accreditation will facilitate communication and decisions in the short term by establishing context.

S-7. The EC Board should consider requesting AB to expeditiously develop a white paper outlining the options for the long term solution, respective pros and cons, and recommended principles for evaluating the options; and further, consider requesting the CEO to assist with staff resources.

Respectfully Submitted,

Larry Staples (chair)	Greg Naterer
Gerard Lachiver	Ishwar Puri
Gerard McDonald	Wayne McQuarrie
Grant Koropatnick	Zaki Ghavitian

APPENDIX C – Balancing Inputs and Outputs Report

Report of a CEAB Task Force (M. Isaacson, W. Lynch, R. Peters, August, 2012) BALANCING INPUTS AND OUTPUTS: Moving to Criteria with Graduate Attributes

BALANCING INPUTS AND OUTPUTS:

Moving to Criteria with Graduate Attributes

Report of a CEAB Task Force (M. Isaacson, W. Lynch, R. Peters, August, 2012)

Summary

The Canadian Engineering Accreditation Board (CEAB) will begin to use evidence concerning the development of graduate attributes in 2015. It is recognized that this outcome-based assessment will be accompanied by continuing review of inputs and processes in the engineering programs applying for accreditation, but it is to be expected that there will be less reliance on the detailed specification of curriculum in the criteria. The purpose of the task force is to assist the CEAB with this transition.

The task force reviewed the accreditation procedures of several other signatories of the Washington Accord (WA). Substantial extracts from documentation of ABET, Engineers Australia and Engineers Ireland are contained in the appendix, in addition to analysis and examples used in the body of this report. While all signatories are claiming to use outcome-based assessment, it is also a fair observation that there is a good deal of variation in the methods and levels of application. ABET is a clear leader in outcome-based development. Australia has extensive documentation, and good linkages with its professional admission practices.

The task force has produced a table (Table 4.1) in which the present criteria are analyzed in relation to the graduate attributes. A preliminary draft of new criteria is presented in section 5.1. The major issue of discussion concerned the extent to which limited curriculum specification needs to be retained, and how to do it. The task force agreed that there needs to be some specification of minimum program length (four years) and the usual curriculum components (natural science, mathematics, design, etc.) that should be expected in every program. The difficult part is to find a way to give reasonable guidance and requirements without falling back into a fully-fledged AU type curriculum analysis as occurs at present. The task force presents two alternatives, one which avoids all use of AU's or equivalent, and the other which expresses the requirements in terms of hours of instruction that are broadly equivalent to AU's.

It is recommended that the CEAB consider the proposals outlined in this report and decide upon the general approach, and then proceed to the detailed writing of criteria.

1 Introduction

Over the last ten years or so, it has become the international standard (e.g. in Washington Accord (WA) countries) that engineering educational accreditation systems use outcome-based assessment as a major tool. In 2008 the CEAB introduced a set of graduate attributes to its criteria. The Board has allowed one accreditation cycle (six years) for institutions to develop assessment systems and for the Board to prepare itself to use outcome-based assessments in making decisions on program accreditation. During that time, and as part of its regular accreditation process, the Board has monitored activity related to assessment systems and reported back to the institutions on their progress. It has also conducted workshops, made presentations, and generally educated itself on the use of this tool. This has been undertaken in close cooperation with the deans of engineering, working through the Deans' Liaison Committee of the Board. Among other things, the National Council of Deans of Engineering and Applied Science (NCDEAS), with cooperation and financial support from Engineers Canada, organized a multi-university project headquartered at Queen's University (Engineering Graduate Attribute Development - EGAD) that has been working on the development of assessment systems.

For the first time in June 2015, the Board will include outcome-based results in making accreditation decisions. This will require a revision of criteria that will shift the balance of the decision-making process toward assessment of the evidence for development of the graduate attributes, and away from reliance on prescriptive input criteria. The purpose of the task force is to assist the Canadian Engineering Accreditation Board with this change in philosophy.

2 Considerations

The mandate of the task force embodied in its name and the title of this report are indicative of the direction taken by the authors. Outcome-based assessment is not a "stand-alone" tool, as will be seen from the results of the research undertaken concerning what others are doing. This also quickly becomes evident to professional bodies involved in accreditation. In theory, one might think that once the targets (graduate attributes, in our case) have been set, the proper assessments made, and a feedback loop is in place to correct inputs and processes as necessary, the system will optimize to meet the required outputs. But in practice, prudent and reasonable people will want to see that human resources, physical resources and academic standards are in place which will enable (not necessarily ensure) the achievement of required program outcomes. There must be people who can maintain administrative structures, keep up with technology and recognize the results of assessment. There must also be physical facilities which make learning possible and reasonably efficient. In addition, learning outcomes will not be created in a vacuum; there must be a body of knowledge with broad properties recognized by engineering professionals to be the basis on which the desired attributes will be built. In the past, the Board has specified this body of knowledge (curriculum) in detail, and it is here that the main changes are expected to take place with the introduction of the graduate attributes. There will continue to be some curriculum guidance, and standards for resource and process inputs. The task force will suggest ways in which the Board can seek a balance between criteria dealing with these aspects, and the assessment of learning outcomes supporting the development of graduate attributes. The task force will try to identify what we want to keep, how we are going to preserve our valued characteristics, and roughly what the new system will look like. It is fully recognized that there will be gaps that the Board, in cooperation with academia and the engineering profession outside of the institutions, will have to decide upon and fill. The first step is to try to get the overall system in place and then refine the details.

3 International Practice

Engineers Canada's Accreditation Board, (established in 1965) has been an active member of the international community involved in engineering program accreditation for many years, and was a founding member of the Washington Accord in 1989. The development of CEAB criteria and processes were initially modeled on those of ABET, in the United States, but with some significant differences. For one thing, the context from within Engineers Canada led to more attention being paid to the place of professional engineering in student education, mentoring and faculty administration. There was also no equivalent involvement from the "learned societies" such as ASCE, IEEE, ASME, etc., as there was in the USA. CEAB has always had only one set of engineering criteria, without discipline-specific components. A significant Canadian innovation in the early nineties was the development of a curriculum analysis tool (our famous "AUs") which set somewhat precise requirements on curriculum components. On the whole the system was and is rigorous (and "robust", to quote the recent WA review) but open to frequent criticism of being overly prescriptive.

ABET moved in the direction of outcome-based assessment when it introduced "Engineering Criteria 2000" (EC2000). Since ABET's move in that direction, there has been a similar overall shift in the international community, and Washington Accord signatories have all followed suit. From the very beginning, the CEAB monitored this development, making good use of the close relationship between the two Boards, with regular participation in ABET accreditation visits and observation of the development of assessment systems. The CEAB was strongly encouraged by the Board of Engineers Canada to bring outcome-based assessment into our criteria. The most recent regular review by a Washington Accord Committee, which extended our signatory status for the maximum six-year period, also recommended accelerated adoption of outcome-based assessments into the CEAB processes.

Over the last ten years, members of the CEAB have been involved in many reviews of WA member countries, including the review processes for several new applicant signatories. This has given us some appreciation of international developments other than those in the USA. It is a fair assessment to say that all signatories are claiming to use outcome-based assessment. But it is also a fair observation that there is a good deal of variation in the methods and levels of application.

In addition to ABET, the task force has examined the latest published criteria in Australia, Ireland, New Zealand, South Africa and the United Kingdom. This report and its appendix contains fairly extensive extracts from ABET, Australia and Ireland. For more details, and for others, the reader is referred to the websites. These three countries give a reasonably broad look at the state of development and variability of practice amongst members of the WA. Engineers Canada has been a participant in WA reviews of all three of these signatories: ABET (O'Brien, Chair 2008); Australia: (Patterson, Chair, 2002); Ireland: (MacQuarrie, Chair, 2010, and Peters, member 2005). ABET is close to us in collaboration and interaction, and a clear leader in outcome-based development. Australia has extensive documentation, and good linkages with its professional admission practices. Ireland is a small jurisdiction, with compact and well written documentation. It also has some linkages with the European community, which is a highly variable and important jurisdiction but which is notably absent (other than Ireland and the UK) from full membership in the WA.

The main reason for looking at the practices in peer countries is to examine the balance between input and outcome assessment. It is also useful to observe the extent to which guidance is given to institutions on assessment processes.

3.1 USA

(For details see: ***http://www.abet.org/***)

The ABET (Engineering Accreditation Commission) criteria are succinct and the documentation is brief and well organized. There are eight general criteria which must be met by all programs. In addition, there are usually discipline-specific program criteria that must also be met. Discipline-specific criteria are the prerogative of the member societies, but are limited to “areas of curricular topics and faculty qualifications”. The general criteria are under the following headings:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

As Board members are well aware, items “a-k” in criterion 3 are more or less equivalent to the CEAB Graduate Attributes. This criterion deals specifically with outcome-based assessments of student learning, although criteria 2 and 4 are obviously also integral parts of the outcome-based system. The ABET definition of assessment includes both student outcomes (criterion 3) and program objectives (criterion 2).

The other criteria include many items dealing with inputs and processes. For example, the general criterion 5 on curriculum specifies the following components:

- one year of a combination of college level mathematics and basic sciences
- one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study
- a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

For the purpose of criterion 5, ABET defines a year as “… the lesser of 32 semester hours (or equivalent) or one-fourth of the total credits required for graduation.”
ABET also continues to require a capstone design project as follows: “Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.”

In addition to its eight general criteria, ABET has 26 sets of discipline-specific or “program criteria” which set additional specifications on areas of curriculum and faculty qualifications. These criteria (and only these) are set by the learned societies involved (ASCE, IEEE, ASME, etc). There is some variation among societies. For example it will be seen that the IEEE does not set a specification on faculty in electrical engineering, but is fairly detailed in curriculum.

ABET's criteria themselves do not identify performance indicators, levels, or set requirements on how institutions measure learning outcomes. The design of the assessment system is the institution's responsibility. But ABET provides a large amount of guideline documentation, workshops and seminars. Links to this material can be found on their website.

3.2 Australia

(For details see: ***http://www.engineersaustralia.org.au/about-us/accreditation-management-system-professional-engineers***)

The above section of the Engineers Australia's website describes the Accreditation Management System of its Accreditation Board. There is a lot of documentation, and it takes some time to navigate and to find the main components in order to make a comparison with the more concise ABET documentation, or for that matter, our own.

The Board divides its documentation into three categories:

- System and Context (S) – four documents;
- Accreditation Guideline (G) – nine documents, and
- Policy (P) – five documents.

The major documents for our purposes on engineering accreditation are: P02: Engineers Australia Policy on Accreditation of Professional Engineering Programs; S02: Accreditation Criteria Summary and G02: Accreditation Criteria Guidelines.

The policy document P02 identifies ten "generic attributes of a graduate" which are similar to those in the CEAB criteria. It then describes "three principal elements which are seen as essential in determining whether the attributes of the graduate engineer are being achieved." The principal elements are identified as the following:

- the teaching and learning environment;
- □the academic program being offered;
- □exposure to professional engineering practice

The teaching and learning environment (first bullet) sets out requirements for appropriate administrative infrastructure, resources, and staff. There are comprehensive requirements for exposure to professional engineering practice (third bullet). The second bullet is the core of any program accreditation. Among other things, it is stipulated that "The minimum requirement for the academic program is a four-year full-time program or equivalent." There are three sub-sections which apply to any academic program, which "are seen as critical to ensuring that the graduates acquire the generic attributes". From this statement, the task force draws the inference that the development of the generic attributes is not measured directly, but depends on the satisfaction of the accreditation criteria. This is reinforced by the sub-section on program structure and content, which sets out expectations for curriculum as follows:

"The program structure and content must be such that the graduates acquire the generic attributes listed in Section 2 and achieve the program objectives.

Typically a four-year professional engineering program should have the following elements:

- mathematics, science, engineering principles, skills and tools (computing, experimentation) appropriate to the discipline of study. This element should not be less than 40% of total program content;

- engineering design and projects. This element should be about 20% of total program content;

- an engineering discipline specialisation. This element should be about 20% of total program content;

- integrated exposure to professional engineering practice (including management and professional ethics). This element should be about 10% of total program content;

- more of any of the above elements or other elective studies. This could be about 10% of total program content."

The Accreditation Criteria themselves are set out in Section 3 of system document S02, under three headings, as follows:

"The criteria for accreditation can be listed in point form as follows.

3.1. The Operating Environment

- Organisational structure and commitment to engineering education.
- Academic and support staff profile.
- Academic leadership and educational culture.
- Facilities and physical resources.
- Funding.
- Strategic management of student profile.

3.2. The Academic Program

- Specification of educational outcomes.
- Titles of Program and award.
- Program structure and implementation framework.
- Curriculum.
- Exposure to engineering practice.

3.3. Quality Systems

- Engagement with external constituencies.
- Feedback and stakeholder input to continuous improvement processes.
- Processes for setting and reviewing the educational outcomes specification.
- Approach to educational design and review.
- Approach to assessment and performance evaluation.
- Management of alternative implementation pathways and delivery modes.
- Dissemination of educational philosophy.
- Benchmarking.
- Approval processes for program development and amendment.
- Student administration."

The next section (4) of document S02 has an extensive tabulation of "performance indicators" correlated to the above criteria. The intended use of these indicators is explained as follows: "The performance indicators listed in the following table provide an interpretation of the expectations associated with each assessment criterion. These performance indicators are included for guidance only and are not meant to be prescriptive. ***In submitting for accreditation, educational institutions are not expected to respond rigorously to every indicator. Sufficient information is expected to be provided such that an evaluation panel is able to make a holistic judgement against the criteria."***

For illustrative purposes, the section relating to the first bullet under the heading "3.2 The Academic Program" above is reproduced below:

Criteria	Performance Indicators
4.2.1 Specification of educational outcomes	• Clearly identified field of engineering practice and specialist focus. • Explicit and comprehensive specification of program objectives and targeted graduate capabilities. • Satisfactory rationale based on analysis of industry and community needs, trends in professional practice and benchmark indicators. • Targeted graduate capabilities embracing the balanced development of enabling skills and knowledge; personal and professional capabilities; engineering application skills; competence in the technical domains comprising the field of practice and high level technical skills in nominated specialist areas. • In-built performance indicators commensurate with an appropriate monitoring methodology. • Targeted graduate capabilities reflecting the Stage 1 Competency Standard. • Explicit mapping of educational outcomes to demonstrate adequate level of attainment of the Engineers Australia Generic Attributes.

The above extract from the table in section 4 is a small portion of all the performance indicators of document S02. In total, there are nearly 100 items relating to the 21 criteria listed above. It is clear that many of these "indicators" are examples of evidence to be assembled in support of a case for accreditation, rather than conforming to the more narrow definitions involving outcomes, rubrics and levels normally associated with outcome based assessment in a formal sense.

The Accreditation Guidelines (G02) is a comprehensive document giving detailed guidance to institutions on the criteria. Some of the guidelines are advisory, but others are mandatory.

Australia's accreditation documentation is extensive, and well correlated with the requirements for entry to the profession. There are no detailed instructions on how to measure outcomes, and institutions are expected to identify their own program objectives and show that they are met. The "generic attributes" are not specifically listed in the accreditation criteria, but are in the Policy document. It appears that once a program has met the criteria for accreditation, the graduates are expected to have developed these attributes, which are frequently referenced in instructions and guidelines.

3.3 Ireland

(For details see: **http://www.engineersireland.ie/services/programme-accreditation/criteria/)**

Engineers Ireland's accreditation document contains criteria for the educational standards for Chartered Engineers, Associate Engineers and Engineering Technicians. From 2013, Engineers Ireland will transition to requiring the Masters degree qualification (which they call level 9) from the present Bachelors (level 8) for registration as a Chartered Engineer (C. Eng.). The Chartered Engineer standard is covered in Part 1 of the document. Part B of Part 1 contains the criteria for accreditation of the Masters Degree programs, which are the most relevant to our discussion.

The following is an extract from the criteria, which sets out the seven program outcomes, from which the first one has been quoted in full. The other six are similarly expanded in the document itself, (see the appendix) but the additional details are not included here. These are the equivalent of our graduate attributes.

"Engineers Ireland specifies the following program outcomes which apply to Master's degree engineering programs (level 9) aimed at satisfying the education standard which will apply to the title of Chartered Engineer from 2013. It is to be understood that these programme outcomes are achieved through the learning outcomes of all modules in all years of the Master's degree programme and any preceding Bachelor's degree programmes. Programmes must enable graduates to demonstrate:

a) Knowledge and understanding of the mathematics, sciences, engineering sciences and technologies underpinning their branch of engineering.

Graduates should have, *inter alia*;

(i) knowledge and understanding of the principles, concepts, limitations and range of applicability of established mathematical tools and methods;

(ii) knowledge and understanding of the theoretical bases and the related assumptions underpinning the engineering sciences relevant to their engineering discipline;

(iii) knowledge and understanding of a wide range of engineering materials, processes and components;

(iv) knowledge and understanding of related developing technologies and how they might impinge upon their branch of engineering;

b) The ability to identify, formulate, analyse and solve engineering problems.

c) The ability to design components, systems or processes to meet specific needs.

d) The ability to design and conduct experiments and to apply a range of standard and specialised research tools and techniques

e) Understanding of the need for high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment.

f) The ability to work effectively as an individual, in teams and in multi-disciplinary settings, together with the capacity to undertake lifelong learning.

g) The ability to communicate effectively with the engineering community and with society at large.

Engineers Ireland criteria also include six "programme areas" which describe curricular elements which must be present in the programme. These are:

(a) Sciences and Mathematics

(b) Discipline-specific Technology

(c) Software and Information Systems

(d) Creativity and Innovation

(e) Engineering Practice

(f) Social and Business Context

These items are further described in a set of "Programme Area Descriptors", which describe in some detail the depth and breadth expected in the curriculum. These descriptors can be found in the appendix to this report. The criteria also contain requirements on faculty quality, resources, funding, and other input variables. There is also a general statement on the assessment, all of which can be seen in the appendix.

4 Review and Proposals for CEAB Criteria

Apart from research and teleconferencing, the task force spent one day in a meeting considering possible changes to criteria. The results of all these deliberations are presented in Table 4.1 below and Section 5 ("Preliminary Outline of Revised Criteria") that follows. The task force also spent a considerable amount of time familiarizing itself with assessment processes, mainly using the results of the EGAD project and the review of WA practice, as described in the last section.

The task force is of the view that, when its final report is received for consideration, the Board should proceed in two phases. First, this report will provide detailed proposals, but will refrain from trying to "wordsmith" actual criteria. The Board should consider these proposals, and after making any necessary adjustments, move to the second phase which is to assign the detailed writing of the various clauses. This task will be much more effectively accomplished if the general direction has been agreed upon beforehand.

The proposed changes are substantial, and the first cycle of program assessments under this regime may be expected to be of varying quality. The Board might want to consider a level of leniency in the first round for each institution to allow for the learning curve. The task force is unsure of how this could be handled, or even if the Board would wish to do it, keeping in mind the potential for inconsistency and expectations in the next round for a given institution. Having raised the possibility, the task force concluded it is probably best left for the Board itself to implement if desired and thought to be practical.

In the following Table 4.1, we put the present criteria (Section 3 of the 2011 Accreditation Criteria and Procedures document) in the left column, and in the right column we make proposals for changes, including new criteria, with the rationale.

4.1 Revising the Criteria

2011 CRITERIA	Comments and proposed modifications of existing criteria
Sections 3.1 and 3.2	These are the present graduate attribute descriptions, and the description of the requirement for a feedback loop. No need to adjust at this time. But the importance of the structure and operation of the continual improvement system (Section 3.2) is central, and this should not be lost sight of in the attention now necessarily focused on graduate attributes themselves.
3.3 Students (and sub-sections 3.3.1-3.3.4)	This section of the present criteria describes administrative processes to ensure proper admission, promotion, etc. No change necessary, except that some material will be added due to changes in other sections.
3.4 Curriculum content and quality: The curriculum content and quality criteria are designed to assure a foundation in mathematics and natural sciences, a broad preparation in engineering sciences and engineering design, and an exposure to non-technical subjects that supplement the technical aspects of the curriculum. All students must meet all curriculum content and quality criteria. The academic level of the curriculum must be appropriate to a university-level engineering program	This opening statement to section 3.4 is equivalent (as least in its objective) to attributes 3.1.1, 3.1.4, 3.1.8, 3.1.9 plus parts of other attributes. The present sections dealing with curriculum – essentially all of section 3.4 - will be extensively revised. Some parts of this introductory statement will still be appropriate, and will re-emerge in the revised document. For discussion purposes, it is envisioned that there will be a new criterion probably called “**3.4 Curriculum**”. It will contain those specifications on curriculum that need to be retained or created. At the very least, there would need to be a requirement for a minimum program length, and certain component subject areas e.g. mathematics, natural science,

	engineering design, etc., or combinations thereof.
3.4.1 Approach and methodologies for quantifying curriculum content (Sub sections 3.4.1.1 to 3.4.1.4)	This criterion describes the process of defining AU, and k-factor. This would no longer be necessary, unless some aspect of the AU computation is to be retained.
3.4.2 Minimum curriculum components: An engineering program must include the minimum for the entire curriculum and for each of its components: • The entire program must include a minimum of 1,950 AU • Mathematics: Minimum 195 AU • Natural sciences: Minimum 195 AU • Mathematics and natural sciences combined: Minimum 420 AU • Engineering science: Minimum 225 AU • Engineering design: Minimum 225 AU • Engineering science and engineering design combined: Minimum 900 AU • Complementary Studies: Minimum 225 AU • Laboratory experience and safety procedures instruction (See 3.4.7)	This is where the greatest change in the present criteria could take place with the introduction of graduate attributes. To the greatest extent possible, we should replace curriculum analysis and the AU tool with a less detailed input guideline, perhaps based on institutional learning measures, e.g. course credit. This will, no doubt, require a good deal of further discussion. The international practices we have examined usually include some form of specification of curriculum content and level. For example, ABET does this in Criterion 5, together with what might be in the program-specific criteria. Australia has it in policy document P02, section 5.2, expressed in proportional form. It is important to realize that all curricula will be linked to the graduate attributes through the curriculum map, and the real test of sufficiency of the curriculum is that the development of the attribute is well demonstrated. In addition, not all attribute development need come through curriculum, but that point is not under discussion here. The task force considered the possibility that, while it may be necessary to set a small number of curriculum requirements, it will be more useful to provide guidelines on what is expected and let the demonstration of the learning outcome be the real test of sufficiency. For the purposes of these guidelines, a curriculum length in terms of years of

	full-time study (suitably defined) could be used, and components could be described in terms of proportions or multiples of years. Each institution has some measure of academic credits (or equivalent) required for its degree, and this may be the basis for curriculum component estimates. An early step will be to decide what subject areas (or combinations) are to be actually specified. ABET uses only three: 1) maths plus basic science; 2) engineering science and engineering design; and 3) general education. We could retain our present five categories, but also consider combinations. The purpose of combinations was originally to provide for flexibility, for example more life sciences and less mathematics. With our focus turned to attribute development, the direction should be that of less input specification. As an example of the kind of thing which is possible, we can start with our present requirement of 1950 AU, and a typical value of the k-factor, say 15. This corresponds to 130 "credits", as commonly used. The requirement of 420 AU of mathematics and natural science, taken together is about 23% (say 30 credits in a 130 credit program). Engineering science and design together would be at least 45% (60 credits in a 130 credit program), and we could further require that neither be less than 12%. Complementary studies would be about 12%. Altogether, 80 % of the total program would be in the specified components, leaving a healthy 20% to permit the institution to choose emphasis as desired. All of these considerations generated a lot of discussion among Task Force members, and in the end, we proposed two alternative curriculum specifications. These will be seen in section 5 (criterion

	3.4.1) of this report.
3.4.3 to 3.4.6 and subsections. 3.4.3 Maths and natural sciences 3.4.3.1 Maths 3.4.3.2 Natural sciences 3.4.4 Engineering science and design 3.4.4.1 Engineering science 3.4.4.2 Other elements of engineering science 3.4.4.3 Engineering design 3.4.4.4 Significant design experience 3.4.4.5 Modern engineering tools 3.4.5 Complementary studies 3.4.5.1 Complementary studies content 3.4.5.2 Language instruction 3.4.6 Total curriculum and level	These sections present elaboration and descriptions of the five curriculum components. The task force suggests the following, working our way down the list: **3.4.3, 3.4.3.1, 3.4.3.2:** These clauses set AU minima and give descriptions of the subjects. The AU requirements would be replaced by the more general guideline on curriculum – tentatively called "**3.4 Curriculum"**. Some or all of the descriptive material on the subjects should be retained as guidelines to the institutions. **3.4.4 and 3.4.4.1:** As in the previous paragraph. **3.4.4.2:** This criterion has been in the CEAB criteria from the beginning, and was likely created to encourage program breadth in technical areas and discourage over-specialization, perhaps in recognition of the fact that we do not have discipline-specific criteria. In our view, its effectiveness is open to question, and it is probably best omitted in the new criteria. If the Board wishes to retain it, it would fit in the new 3.4. **3.4.4.3 and 3.4.4.4:** These two clauses give the description of engineering design, and the requirement for a culminating design experience. The minimum 225 AU requirement is also restated. Apart from the AU requirement in its present form, all of this material should be retained. Note that the reference to supervision by licensed engineers is included here, and should be retained. **3.4.4.5:** Attribute 3.1.5 (use of engineering tools) is specific on modern engineering tools, and this clause should now be omitted.

	3.4.5 and 3.4.5.1: The strict minimum AU requirement may possibly be discontinued, but some reference to complementary studies should appear in the required curriculum content. Clause 3.4.5.1 is presently a very specific listing of topics, and almost all of them occur in the attributes. For example health and safety risks, applicable standards, economic, environmental, cultural and societal considerations are all present in attribute 3.1.4 (design). Communication skills; professionalism; impact of technology; ethics and equity and economics and project management are the entire subjects of attributes 3.1.7, 3.1.8, 3.1.9 and 3.1.10. The attention to these topics is greatly increased, compared to present criteria. What is not present in the graduate attributes is any reference to humanities and social sciences and this is entirely consistent with the WA practice. However, the task force is of the view that this is a critical component that needs to be retained in the revised criteria. **3.4.5.2:** This is a very specific clause dealing with limitations on the use of language instruction to meet certain curriculum requirements. These requirements would no longer exist, so the clause would not be required. **3.4.6:** This clause sets a minimum total curriculum as 1950 AU (extended from 1,800 a few years ago), but also requires it to be at "university level". The length requirement would have to be restated, and "degree credits" or the equivalent, or a modified use of AU are possibilities. ABET uses "years" defined in terms of "semester hours" or credits. Australia and some others simply use "years of full time study, or equivalent". This has been discussed above in 3.4.2.

3.4.7 Appropriate laboratory experience must be an integral component of the engineering curriculum. Instruction in safety procedures must be included in preparation for students' laboratory and field experience.	The idea in this clause should be retained. This could be done in the description of sciences in new criterion 3.4, by requiring that some of the science have laboratory experience, or by writing a separate sub-clause.
3.4.8 The requirements for curriculum content must be satisfied by all students, including those claiming advanced standing, credit for prior post-secondary level studies, transfer credits and/or credit for exchange studies. The document entitled *Advanced Standing, Prior Studies, Exchange Studies, and Transfer Credit Regulations*, is available as an appendix in this document.	Section 3.3.2 makes the point that all regulations must apply to all students. Move the required parts to **3.3**: **students**, (admission).
3.4.8.1 It is recognized that, for programs at some institutions, some of the mathematics, natural sciences and complementary studies components of the curriculum may have been covered in prior university level (or post-secondary) education and this circumstance must be considered in the institution's admission policy.	Move to **3.3**: **students**, (admission), add to the present statement. Reference to specific curriculum components would not now be necessary, since numerical criteria would not be in use – at least not in the same sense as in the old criteria.
3.4.8.2 These criteria do not limit accreditation to any particular mode of learning. In the case of distance learning, the Accreditation Board will rely on the Statement of Interpretation on Distance Learning, which is attached as an appendix to this document.	This could also be shifted to section 3.3 (Students) – probably given a separate sub-section, following degree auditing, to which it relates.
3.5 Program environment: The Accreditation Board considers the overall environment in which an engineering program is delivered.	
3.5.1 and subsections, Quality of the educational experience:	Not affected by introduction of graduate attributes
3.5.2 and subsections, Faculty:	As above
3.5.3 Leadership: The dean of engineering (or equivalent officer) and the head of an engineering program (or equivalent officer with overall responsibility for each engineering program) are expected to provide effective leadership in engineering education and to have high	This requirement on the dean etc. should be kept, but it is not apparent what the statement on licensure has to do with it. Shaded part doesn't really belong, is it in the present document by mistake? Omit.

standing in the engineering community. They are expected to be engineers licensed in Canada, preferably in the jurisdiction in which the institution is located. In those jurisdictions where the teaching of engineering is the practice of engineering, the officers are expected to be engineers licensed in that jurisdiction. To evaluate this criterion, the Accreditation Board will rely on the Statement of Interpretation on Licensure Expectations and Requirements, which is attached as an appendix to this document.	
3.5.4 Expertise and competence of faculty: Faculty delivering the engineering curriculum are expected to have a high level of expertise and competence, and to be dedicated to the aims of engineering education and of the self-regulating engineering profession, which will be judged by the following factors: • The level of academic education of its members. • The diversity of their backgrounds, including the nature and scope of their non-academic experience. • Their ability to communicate effectively. • Their experience in teaching, research, and design practice. • Their level of scholarship as shown by scientific, engineering, and professional publications. • Their degree of participation in professional, scientific, engineering, and learned societies. • Their personal interest in, and documented support of, the curriculum and program-related extra-curricular activities. • Their appreciation of the role and importance of the self-regulating engineering profession, and of positive attitudes towards professional licensure and involvement in professional affairs.	Not affected by introduction of graduate attributes
3.5.5 Professional status of faculty members: Faculty delivering curriculum	Without "qualified AU's" this will have to be revised. Dropping the shaded portion

content that is engineering science and/or engineering design are expected to be licensed to practise engineering in Canada, preferably in the jurisdiction in which the institution is located. In those jurisdictions where the teaching of engineering is the practice of engineering, they are expected to be licensed in that jurisdiction. To evaluate this criterion, the Accreditation Board will rely on the *Statement of Interpretation on Licensure Expectations and Requirements*, which is attached as an appendix to this document.	would revert the clause back to its form prior to linking it to AU's. That is the task force's recommendation.
3.5.6 Financial resources, 3.5.7 Authority and responsibility for the engineering program, 3.5.8 Curriculum committee	Unaffected by introduction of graduate attributes
3.6 Accreditation procedures and application	Unaffected by introduction of graduate attributes

5 Preliminary Outline of the Revised Criteria

As was recommended in an earlier section, the task force suggests that the Board consider the proposals in this report before detailed writing of the criteria is undertaken. But it would be useful for us to assemble the foregoing proposals into a preliminary document to help consolidate the results. There will be some gaps, and undecided steps, but we think it will be helpful.

It will come as no surprise that the section of the present (2011) criteria which presented the greatest challenge for the task force was **3.4 Curriculum content and quality**, with its existing detailed specification of curriculum in terms of accreditation units. The amount of detail and the degree of rigorous specification of curriculum to be retained in an outcome-based system occupied a great deal of the task force time and discussion. Among WA signatories, there is considerable variation. For example, South Africa retains (at least for now) quantification of curriculum to a fairly high degree; Australia and ABET less so, and Ireland hardly at all.

The task force could not reach a consensus on a single approach, and perhaps that is neither surprising nor is a single approach even the most useful target for the task force. Instead of struggling to reach an unsatisfactory compromise, the task force agreed to present two alternatives in this draft criteria document, one with a smaller amount of quantification, and another which preserves more of the rigour of the present AU system. It will probably be more efficient for the Board to choose between alternatives than it would be to have a single point of departure for discussion. Indeed, other options than these two alternatives are possible, with either less or more rigour with respect to quantification of the total program load and of the key curriculum components. Both alternatives retain a required four-year minimum total program length, which is general in the WA, and both suggest guidelines for curriculum components.

Alternative A proposes what is intended to be a minimum specification on curriculum. The institution would be expected to provide evidence that the total curriculum and the components meet the guidelines which have been set down, but the manner in which it does this is not specified in the criterion. There are other ways of doing this if the Board so desires, for example in the questionnaire. One of the admitted problems with using proportions for curriculum components (proposed in alternative A) is that longer programs can be unfairly constrained. This can be dealt with by making allowances in such cases, i.e. a smaller percentage could be accepted for a component in a program which is longer than four years. One of the intentions of alternative A is to make the test for sufficiency of the curriculum to be the satisfaction of those graduate attributes linked to it. This is based on the logic that if the graduate attributes associated with curriculum have met requirements, it does not make much sense to say that curriculum is inadequate.

With regard to the alternative B providing a greater level of quantification, the task force elected to express these using equivalent instructional hours, largely corresponding to the current AU's. In proposing these, it should be noted that relaxations relative to current AU requirements would be introduced as follows: (i) there would be a reduction in the minimum program load from 1,950 AU's to 1,800 AU's; (ii) each institution would have the discretion to define equivalent instructional hours for laboratories, tutorials, projects and other modes of instruction as it considers appropriate; and (iii) there would no longer be constraints associated with "qualified AU's." Also under this alternative, curricula components would continue to be expressed in terms of minimum hours of instruction rather than minimum percentages. This is because the latter is considered to be unduly restrictive for those programs that include specific content beyond minimum requirements (e.g. as occurs in some 5-year programs).

The task force has referred earlier to the possibility that the Board might wish to provide a transition from the present system to the full application of outcome based assessment. The two alternate levels of curriculum input specification could be useful in this respect, moving from B to A as confidence is gained in the new system.

What follows is a rough draft of modified criteria, working from the 2011 structure. The numbered listing refers to **section 3 of the 2011 Accreditation Procedures and Criteria booklet.** New (or moved) material is added in italics. Material to be omitted is struck out.

5.1 Draft of Revised Criteria, Based on Table 4.1

(NB – numbering below from 2011 Criteria Document, except for new material)

3.1 Graduate attributes: no change.

3.2 Continual improvement: no change.

3.3 Students: introductory statement - no change.

3.3.1 Admission: There must be documented processes and policies for admission of students. Admission involving advanced standing, prior studies, transfer credits and/or exchange studies must be in compliance with the associated Accreditation Board regulations. The document entitled Advanced Standing, Prior Studies, Exchange Studies, and Transfer Credit Regulations, is available as an appendix in this document. *It is recognized that, for programs at some institutions, some of the mathematics, natural sciences and complementary studies components of the curriculum may have been covered in prior university level (or post-secondary) education and this circumstance must be considered in the institution's admission policy."*

3.3.2 Promotion and graduation: no change

3.3.3 Counselling and guidance: no change

3.3.4 Degree auditing: no change

3.3.5 Learning modes: *These criteria do not limit accreditation to any particular mode of learning. In the case of distance learning, the Accreditation Board will rely on the Statement of Interpretation on Distance Learning, which is attached as an appendix to this document.*

3.4 Curriculum: *The use of outcome-based assessment as a major tool in accreditation of engineering programs is accompanied by a move away from specification of curriculum. Nevertheless, some broad guidance is considered to be necessary if the graduate attributes are to be developed during the learning process. Except where the word "must" is explicitly used, the expectations in the following paragraphs 3.4.1 - 3.4.8 are intended as guidelines and not prescriptions of curriculum.* [As indicated earlier, the task force presents below two alternatives of Section 3.4.1 in this draft document, one with lesser and the other with greater levels of curriculum quantification.]

Alternative A

3.4.1A Curriculum quality and structure: *The curriculum content and quality must make it possible to obtain a foundation in mathematics and natural sciences, a broad preparation in engineering sciences and engineering design, and an exposure to non-technical subjects. The academic level of the curriculum must be appropriate to a university-level engineering program. The degree must comprise at least four years (eight semesters) of full-time study. As a guide, a full-time semester typically comprises of a minimum of 225 instruction hours, where an instruction hour is defined as 1 hour of lecture (corresponding to 50 minutes of activity) or a corresponding duration for laboratories, projects and other modes of instruction as deemed appropriate by the institution. The curriculum should contain the following components in the proportions indicated below. The test for sufficiency of the curriculum is in the development of graduate attributes which are linked to it.*

Mathematics and natural sciences: At least 23%,
Engineering sciences and design: At least 45%, neither less than 12 %
Complementary studies: At least 12%.

Alternative B

***3.4.1B Curriculum quality and structure:** The curriculum content and quality must make it possible to obtain a foundation in mathematics and natural sciences, a broad preparation in engineering sciences and engineering design, and an exposure to non-technical subjects. The academic level of the curriculum must be appropriate to a university-level engineering program. The degree must comprise at least 1,800 instructional hours. Instructional hours are equivalent to Accreditation Units (AU's), except that each institution may define equivalent instruction hours for laboratories, tutorials, projects and other modes of instruction as it considers appropriate.*

The curriculum should contain the following component AU's:

Mathematics and natural sciences: at least 420,
Engineering sciences and design: at least 900, neither less than 225
Complementary studies: at least 225

***3.4.2 Mathematics:** Mathematics is expected to include appropriate elements of linear algebra, differential and integral calculus, differential equations, probability, statistics, numerical analysis, and discrete mathematics. What is appropriate will depend on the program.*

***3.4.3 Natural science:** The natural sciences component of the curriculum is expected to include elements of physics and chemistry. Elements of life sciences and earth sciences would also be included in this category, as appropriate to the program. These subjects are intended to impart an understanding of natural phenomena and relationships through the use of analytical and/or experimental techniques. An Interpretive Statement on Natural Sciences is attached as an appendix to this document.*

***3.4.4 Engineering science:** Engineering science subjects involve the application of mathematics and natural science to practical problems. They may involve the development of mathematical or numerical techniques, modeling, simulation, and experimental procedures. Such subjects include, among others, the applied aspects of strength of materials, fluid mechanics, thermodynamics, electrical and electronic circuits, soil mechanics, automatic control, aerodynamics, transport phenomena, and elements of materials science, geoscience, computer science, and environmental science.*

***3.4.5 Engineering design:** Engineering design integrates mathematics, natural sciences, engineering sciences, and complementary studies in order to develop elements, systems, and processes to meet specific needs. It is a creative, iterative, and open-ended process, subject to constraints which may be governed by standards or legislation to varying degrees depending upon the discipline. These constraints may also relate to economic, health, safety, environmental, societal or other interdisciplinary factors.*

3.4.6 Complementary studies: *Complementary studies complement the technical content of the curriculum. There should be some exposure to the humanities and/or social sciences, in order to impart some appreciation of the central issues and thought processes in these disciplines. Engineering economics, management and communications are also included in this area.*

3.4.7 Significant design experience: *The engineering curriculum must culminate in a significant design experience conducted under the professional responsibility of faculty licensed to practise engineering in Canada, preferably in the jurisdiction in which the institution is located. The significant design experience is based on the knowledge and skills acquired in earlier work and it preferably gives students an involvement in team work and project management.*

3.4.8 Laboratory experience: *Appropriate laboratory experience must be an integral component of the engineering curriculum. Instruction in safety procedures must be included in preparation for students' laboratory and field experience.*

3.5 Program environment: Introductory statement – no change

3.5.1, 3.5.1.1, 3.5.1.2 Quality of the educational experience: no change.

3.5.2, 3.5.2.1, 3.5.2.2, 3.5.2.3, 3.5.2.4, 3.5.2.5 Faculty: no change

3.5.3 Leadership: The dean of engineering (or equivalent officer) and the head of an engineering program (or equivalent officer with overall responsibility for each engineering program) are expected to provide effective leadership in engineering education and to have high standing in the engineering community. They are expected to be engineers licensed in Canada, preferably in the jurisdiction in which the institution is located. In those jurisdictions where the teaching of engineering is the practice of engineering, the officers are expected to be engineers licensed in that jurisdiction~~. To evaluate this criterion, the Accreditation Board will rely on the Statement of Interpretation on Licensure Expectations and Requirements, which is attached as an appendix to this document.~~

3.5.4 Expertise and competence of faculty: no change.

3.5.5 Professional status of faculty members: Faculty delivering curriculum content that is engineering science and/or engineering design are expected to be licensed to practise engineering in Canada, preferably in the jurisdiction in which the institution is located. In those jurisdictions where the teaching of engineering is the practice of engineering, they are expected to be licensed in that jurisdiction. ~~To evaluate this criterion, the Accreditation Board will rely on the Statement of Interpretation on Licensure Expectations and Requirements, which is attached as an appendix to this document.~~

3.5.6 Financial resources: no change.

3.5.7 Authority and responsibility for the engineering program: no change.

3.5.8 Curriculum committee: no change.

3.6 Accreditation procedures and application: no change

Criteria appendices: [*Advanced Standing and Professional Licensure documents will need rewriting, particularly where there are AU-related procedures.]*

6 Conclusions

The task force reviewed the accreditation criteria and procedures of several WA countries, in particular the United States, Australia and Ireland. There is a good deal of variability in the stages of development. In all cases, methods of assessment are left to the institutions to develop, although a lot of guidance is given through published material and workshops, especially in the case of the well-developed systems such as ABET.

Table 4.1 in Section 4 of the report contains an analysis of present criteria in the context of the introduction of outcome based assessment, and Section 5 assembles these changes in the form of a very preliminary draft of a new version of the criteria. Recommendations in the table show that the task force is suggesting a substantial move toward using evidence provided by the programs on the development of the graduate attributes, and away from the present emphasis on curriculum. But even though the changes are significant, it will be noted that many sections of criteria will require little or no change. Obviously, the big changes will be where the AU tool is currently used. The present detailed curriculum analysis would be discontinued, although guidelines remain on minimum program subject components, as well as a requirement that the minimum program length be four years, or its equivalent. The task force did not arrive at a consensus on the best way to express the minimum program length and the remaining curriculum specification, and instead, presents two alternatives. One of these uses "hours of instruction", which is equivalent to the AU, but with more freedom left to the institution to choose the exact calculation method. The other expresses components in percentage terms, observing that the test for sufficiency of the curriculum is the satisfactory development of those attributes linked to it.

It is recommended that the notion of "qualified AU's" will no longer be available. No changes in criteria dealing with professional status have been suggested, but the methods of assessing compliance will presumably revert to the earlier system, or something new will have to be developed.

The task force made some suggestions that are not AU-related. One of these is that the criterion dealing with "other elements of engineering science" (3.4.4.2) be dropped. Another deals with the description of complementary studies, and the preservation of some exposure to the humanities and social sciences.

Finally, the task force is acutely aware that much remains to be done before the new system is fully operational. The task force has tried to define the framework within which the detailed revisions to the criteria can now be made.

Appendix

Extracts from criteria documentation: (1) USA; (2) Australia; (3) Ireland.

(1) USA: ABET Criteria for Accrediting Engineering Programs, 2011 - 2012

DEFINITIONS

While ABET recognizes and supports the prerogative of institutions to adopt and use the terminology of their choice, it is necessary for ABET volunteers and staff to have a consistent understanding of terminology. With that purpose in mind, the Commissions will use the following basic definitions:

Program Educational Objectives
Program educational objectives are broad statements that describe what graduates are expected to attain within a few years after graduation. Program educational objectives are based on the needs of the program's constituencies.

Student Outcomes
Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills, and behaviors that students acquire as they progress through the program.

Assessment
Assessment is one or more processes that identify, collect, and prepare data to evaluate the attainment of student outcomes and program educational objectives. Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the outcome or objective being measured. Appropriate sampling methods may be used as part of an assessment process.

Evaluation
Evaluation is one or more processes for interpreting the data and evidence accumulated through assessment processes. Evaluation determines the extent to which student outcomes and program educational objectives are being attained. Evaluation results in decisions and actions regarding program improvement.

The criteria for accreditation are in two sections.

1. General Criteria apply to all programs accredited by an ABET commission. Each program accredited by an ABET commission must satisfy every Criterion that is in the General Criteria for that commission.

2. Program Criteria provide discipline specific accreditation criteria. Programs must show that they satisfy all of the specific Program Criteria implied by the program title. Any overlapping requirements need be satisfied only once.

I. GENERAL CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS

All programs seeking accreditation from the Engineering Accreditation Commission of ABET must demonstrate that they satisfy all of the following General Criteria for Baccalaureate Level Programs.

Criterion 1. Students

Student performance must be evaluated. Student progress must be monitored to foster success in attaining student outcomes, thereby enabling graduates to attain program educational objectives. Students must be advised regarding curriculum and career matters.

The program must have and enforce policies for accepting both new and transfer students, awarding appropriate academic credit for courses taken at other institutions, and awarding appropriate academic credit for work in lieu of courses taken at the institution. The program must have and enforce procedures to ensure and document that students who graduate meet all graduation requirements.

General Criteria 2. Program Educational Objectives

The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented and effective process, involving program constituencies, for the periodic review and revision of these program educational objectives.

General Criteria 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

General Criteria 4. Continuous Improvement

The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which both the program educational objectives and the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.

General Criteria 5. Curriculum

The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:

(a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences.

(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.

(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.

One year is the lesser of 32 semester hours (or equivalent) or one-fourth of the total credits required for graduation.

General Criteria 6. Faculty

The faculty must be of sufficient number and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students.

The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program, its educational objectives and outcomes. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching effectiveness and experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and licensure as Professional Engineers.

General Criteria 7. Facilities

Classrooms, offices, laboratories, and associated equipment must be adequate to support attainment of the student outcomes and to provide an atmosphere conducive to learning. Modern tools, equipment, computing resources, and laboratories appropriate to the program must be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and to support program needs. Students must be provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories available to the program.

The library services and the computing and information infrastructure must be adequate to support the scholarly and professional activities of the students and faculty.

General Criterion 8. Institutional Support

Institutional support and leadership must be adequate to ensure the quality and continuity of the program.

Resources including institutional services, financial support, and staff (both administrative and technical) provided to the program must be adequate to meet program needs. The resources available to the program must be sufficient to attract, retain, and provide for the continued professional development of a qualified faculty. The resources available to the program must be sufficient to acquire, maintain, and operate infrastructures, facilities, and equipment appropriate for the program, and to provide an environment in which student outcomes can be attained.

III. PROGAM CRITERIA (NB: For the illustrative purposes in this Task Force Report, only program criteria for Civil, Electrical and Mechanical are included.)

Each program must satisfy applicable Program Criteria (if any). Program Criteria provide the specificity needed for interpretation of the baccalaureate level criteria as applicable to a given discipline. Requirements stipulated in the Program Criteria are limited to the areas of curricular topics and faculty qualifications. If a program, by virtue of its title, becomes subject to two or more sets of Program Criteria, then that program must satisfy each set of Program Criteria; however, overlapping requirements need to be satisfied only once.

Program Criteria for Civil and Similarly Named Engineering Programs

Lead Society: American Society of Civil Engineers

These program criteria apply to engineering programs including "civil" and similar modifiers in their titles.

1. Curriculum

The program must prepare graduates to apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of basic science, consistent with the program educational objectives; apply knowledge of four technical areas appropriate to civil engineering; conduct civil engineering experiments and analyze and interpret the resulting data; design a system, component, or process in more than one civil engineering context; explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.

2. Faculty
The program must demonstrate that faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience. The program must demonstrate that it is not critically dependent on one individual.

Program Criteria for Electrical, Computer, and Similarly Named Engineering Programs
Lead Society: Institute of Electrical and Electronics Engineers
Cooperating Society for Computer Engineering Programs: CSAB

These program criteria apply to engineering programs that include electrical, electronic, computer, or similar modifiers in their titles.

1. Curriculum
The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.

The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computing science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.

The curriculum for programs containing the modifier “electrical” in the title must include advanced mathematics, such as differential equations, linear algebra, complex variables, and discrete mathematics.

The curriculum for programs containing the modifier “computer” in the title must include discrete mathematics.

Program Criteria for Mechanical and Similarly Named Engineering Programs
Lead Society: American Society of Mechanical Engineers

These program criteria will apply to all engineering programs including "mechanical" or similar modifiers in their titles.

1. Curriculum
The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in both thermal and mechanical systems areas.

2. Faculty
The program must demonstrate that faculty members responsible for the upper-level professional program are maintaining currency in their specialty area.

(2) AUSTRALIA

POLICY P02

ENGINEERS AUSTRALIA

ACCREDITATION BOARD
ACCREDITATION MANAGEMENT SYSTEM

EDUCATION PROGRAMS AT THE LEVEL OF PROFESSIONAL ENGINEER

DOCUMENT STATUS Revision 1
Prepared by: Associate Director, Accreditation, Professor Alan Bradley
Authorised by: Chair of the Accreditation Board, Professor Mike Brisk
Issue Date: 19/07/06
Document No. P02
Title: Engineers Australia Policy on Accreditation of Professional Engineering Programs

1. PREAMBLE

University education provides the learning base upon which competence for a professional engineering career is built. It is important that the education provides the graduate with the generic attributes listed in Section 2 below.

It is equally important that the education process be accredited by Engineers Australia to give confidence to the students, the universities and the profession that the education will indeed provide a graduate with the required attributes. Through the process of accreditation of university education, as the representative of the profession, Engineers Australia will:

- ensure that graduates from an accredited program are adequately prepared to enter and to continue the practice of engineering;
- promote best practice;
- promote the standing of accredited programs to members and potential members of the engineering profession in Australia.

2. THE GENERIC ATTRIBUTES OF A GRADUATE

Graduates from an accredited program should have the following attributes:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;

- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;

- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;

- understanding of the principles of sustainable design and development;

- understanding of professional and ethical responsibilities and commitment to them; and

- expectation of the need to undertake lifelong learning, and capacity to do so.

3. PRINCIPAL ELEMENTS OF ENGINEERS AUSTRALIA ACCREDITATION PROCESS

There are three principal elements in the Engineers Australia accreditation system which are seen as essential in determining whether the attributes of the graduate engineer are being achieved. These are:

- the teaching and learning environment;

- the academic program being offered;

- exposure to professional engineering practice.

4. THE TEACHING AND LEARNING ENVIRONMENT

The following must be in place within the teaching and learning environment:

- an identifiable structure responsible for engineering education within the university;

- a strategic statement by the university on engineering education;

- an effective advisory mechanism involving industry participation;

- capabilities in terms of staffing and resources to ensure that the stated objectives can be met.

5. THE ACADEMIC PROGRAM BEING OFFERED

The minimum requirement for the academic program is a four-year full-time program or equivalent. The following elements of the academic program are seen as critical to ensuring that the graduates acquire the generic attributes listed in Section 2:

5.1. Program Philosophy and Objectives

There must be a clear statement of the mission and the objective for each program and of the broad characteristics expected of a graduate.

5.2. Program Structure and Content

The program structure and content must be such that the graduates acquire the generic attributes listed in Section 2 and achieve the program objectives.

Typically a four-year professional engineering program should have the following elements:

- mathematics, science, engineering principles, skills and tools (computing, experimentation) appropriate to the discipline of study. This element should not be less than 40% of total program content;

- engineering design and projects. This element should be about 20% of total program content;

- an engineering discipline specialisation. This element should be about 20% of total program content;
- integrated exposure to professional engineering practice (including management and professional ethics). This element should be about 10% of total program content;
- more of any of the above elements or other elective studies. This could be about 10% of total program content.

5.3. Program Standard

The university must employ some method of external benchmarking to ensure that the program material and standards reflect relevant best practice.

6. EXPOSURE TO PROFESSIONAL ENGINEERING PRACTICE

The students must be exposed to professional engineering practice integrated throughout their program to enable them to develop an engineering approach and ethos, and to gain an appreciation of professional engineering ethics. The purpose of this is to facilitate their entry into the profession and to better prepare them to be able to develop the attributes listed in Section 2. This exposure must include:

- use of staff with industry experience;
- practical experience in an engineering environment outside the teaching establishment;
- mandatory exposure to lectures on professional ethics and conduct.

Exposure to professional engineering practice may also be obtained through a combination of the following:

- use of guest lecturers;
- use of industry visits and inspection;
- an industry based final year project;
- regular use of a logbook in which experiences are recorded.

7. THE ACCREDITATION PROCESS

The Engineers Australia accreditation process will increasingly focus on outcomes as the universities develop internal systems which ensure that the graduate is adequately prepared to enter the engineering profession. It will enable universities to play a more significant role in the accreditation process.

The concept involves quality assurance systems and processes being in place which will ensure that the graduate is adequately prepared to enter the practice of engineering. As universities develop internal processes which cover much common ground with the professional accreditation undertaken by Engineers Australia, there is scope for improved efficiency by minimising duplication in the two processes.

Engineers Australia will visit at five-year intervals to ensure that the education that is being delivered provides the graduates with the attributes listed in Section 2. During the visit emphasis will be placed on verification of the standards reached by the students through detailed inspection of the applicable quality output measures.

SYSTEM AND CONTEXT S02

ENGINEERS AUSTRALIA

ACCREDITATION BOARD
ACCREDITATION MANAGEMENT SYSTEM
EDUCATION PROGRAMS AT THE LEVEL OF PROFESSIONAL ENGINEER
DOCUMENT STATUS
Revision 2
Prepared by: Associate Director, Accreditation Professor Alan Bradley
Authorised by: Chair of the Accreditation Board Professor Robin King
Issue Date: 30/8/08
Document No. S02
Title: Accreditation Criteria Summary

1. INTRODUCTION

Engineers Australia as the National competency authority responsible for the accreditation of professional engineering education programs in Australia provides a range of documents within its Accreditation Management System. These documents provide a resource for both engineering educators and for those responsible for the accreditation function. An index of the documents comprising the Accreditation Management System is provided in 'Engineers Australia – Accreditation Management System – Document Listing'.

The key criteria underpinning the accreditation process are summarised in the discussion to follow. The accreditation criteria provide the basis for evaluation of engineering education programs and also provide, for engineering educators, a resource for the review and development of the teaching and learning environment, for the educational design and review tasks and for the processes of continuous quality improvement.

2. CONTEXTUAL SETTING

The generic attributes defined in the Engineers Australia Policy on Accreditation of Professional Engineering Programs, (Reference 1), and more particular the Engineers Australia National Generic Competency Standards – Stage 1 Competency Standard for Professional Engineers (Reference 2), provide a common platform for the design of education programs aimed at preparing students for practice in a particular field or discipline of engineering. Graduates must be competent in the technical domains underpinning the particular engineering discipline and be equipped with high level skills and knowledge in one or more specialist areas within the discipline. In addition, graduates must be equipped with the engineering abilities and professional attributes underpinning all domains of engineering practice.

The Stage 1 Competency Standard also provides a tool for direct assessment, in a generic sense, of the preparedness of a candidate not holding an accredited or recommended qualification for entry to the profession.

The targeted graduate capabilities for a program in a particular discipline must, in a generic sense, be built on and reflect these Stage 1 competencies. Graduate capabilities would be expected to embrace enabling skills and knowledge, depth and breadth of technical competence, engineering application skills as well as personal and professional capabilities. The accreditation criteria have been devised as a means of assessing the potential for a particular engineering education program, delivered within an appropriate educational setting, to deliver graduates equipped with the Stage 1 competencies defined in Reference 2.

The assessment of graduate outcomes by an educational institution will be multidimensional and based on performance measures, feedback and inputs distributed throughout the program of study. The accreditation criteria address inputs, content, and processes as well as direct outcomes. As to be expected the criteria correlate strongly with the Stage 1 competencies and associated performance indicators.

3. THE ACCREDITATION CRITERIA

The criteria for accreditation can be listed in point form as follows.

3.1. The Operating Environment

- Organisational structure and commitment to engineering education.
- Academic and support staff profile.
- Academic leadership and educational culture.
- Facilities and physical resources.
- Funding.
- Strategic management of student profile.

3.2. The Academic Program

- Specification of educational outcomes.
- Titles of Program and award.
- Program structure and implementation framework.
- Curriculum.
- Exposure to engineering practice.

3.3. Quality Systems

- Engagement with external constituencies.
- Feedback and stakeholder input to continuous improvement processes.
- Processes for setting and reviewing the educational outcomes specification.
- Approach to educational design and review.
- Approach to assessment and performance evaluation.
- Management of alternative implementation pathways and delivery modes.
- Dissemination of educational philosophy.
- Benchmarking.
- Approval processes for program development and amendment.
- Student administration.

Performance indicators against each criterion are introduced in Section 4 of this document.

Detailed discussion against each criterion is provided in the guidelines of Reference 3.

Reference 4 provides guidance in the preparation of accreditation submission documentation, and again systematically follows the accreditation criteria.

The criteria under Section 3.2 above, '*The Academic Program*', will need to be addressed independently for the evaluation of each individual program offered by a provider. The remaining criteria under the headings of *'The Operating Environment*' and *'Quality Systems'* must again be applied to each program however in many cases, a unified analysis either for all programs or groups of programs, will be appropriate because of a common operating environment.

4. ACCREDITATION CRITERIA – INDICATORS OF PERFORMANCE

The performance indicators listed in the following table provide an interpretation of the expectations associated with each assessment criterion. These performance indicators are included for guidance only and are not meant to be prescriptive. ***In submitting for accreditation, educational institutions are not expected to respond rigorously to every indicator. Sufficient information is expected to be provided such that an evaluation panel is able to make a holistic judgement against the criteria.***

The guidelines of Reference 3 more clearly demarcate the absolute requirements for accreditation from the expectations of performance. Again the emphasis is on encouraging innovation and diversity in educational design and delivery.

4.1. The Operating Environment

Criteria	Performance Indicators
4.1.1 Organisational structure and commitment to engineering education	• Substantive, organisational entity with clearly designated and devolved accountability for leadership and management of engineering education programs. • Long term, institutional commitment and strategic management to assure the development of the engineering discipline and the provision of appropriate resources. • Formally constituted committee structures and mechanisms for program review and approval.
4.1.2 Academic and support staff profile	• Adequate academic staff numbers, balanced profile across academic appointment levels. • Appropriate student/staff ratios. • Effective workload policies and practices. • Effective student learning support mechanisms. • Gender balance. • Appropriate depth, mix and distribution of qualifications, experience and engineering practice exposure, scholarship and professional standing. • Match of staff competency profile to the range of specialist program offerings. • Appropriate policy and record of staff development – both pedagogical and professional skills. • Staff awareness of gender and cross-cultural issues, inclusive teaching approach. • Strategic use of sessional and industry presenters to enrich staff skills profile and the exposure of students. • Adequate student counselling and advisory services. • Appropriate technical and administrative support staff profiles.
4.1.3 Academic leadership and educational culture	• Effective leadership of a cohesive teaching team, driving the educational design and improvement process at individual program level. • Program team inclusive of all teaching staff.

	• Dynamic, cooperative learning community. • Progressive pedagogical framework, adoption of best practice. • Cooperative industry and community outreach. • Interlinked research and teaching programs. • Staff role modelling the generic engineering attributes. • Inclusive environment – gender, culture, social differences – encouraging diversity and the development of the individual. • Developing staff as learning facilitators in a cooperative learning environment.
4.1.4 Facilities and physical resources	• Appropriate experimental and project based facilities to support both structured and investigatory learning within the specified field of practice and specialisation. • Adequate IT facilities and support. • Access to simulation, visualisation, analysis, design, documentation, planning, communication and management tools as well as test and measurement equipment and information resources appropriate to current industry practice. • Learning support facilities appropriate to the development of the full range of educational outcomes and matching the needs of the individual.
4.1.5 Funding	• Sound business planning accommodating current commitments and proposed developments. • Appropriate funding formula for distribution to and within the engineering school. • Ongoing viability - ability to deliver current commitments and projected developments.
4.1.6 Strategic management of student profile	• Viable student numbers and trends. • Appropriate admission, retention and progression record, Honours and graduation rates commensurate with performance indicators. • Rigorous processes for analysis, assessment and verification of prior learning for advanced standing.

4.2 Academic Programs

Criteria	Performance Indicators

4.2.1 Specification of educational outcomes	• Clearly identified field of engineering practice and specialist focus. • Explicit and comprehensive specification of program objectives and targeted graduate capabilities. • Satisfactory rationale based on analysis of industry and community needs, trends in professional practice and benchmark indicators. • Targeted graduate capabilities embracing the balanced development of enabling skills and knowledge; personal and professional capabilities; engineering application skills; competence in the technical domains comprising the field of practice and high level technical skills in nominated specialist areas. • In-built performance indicators commensurate with an appropriate monitoring methodology. • Targeted graduate capabilities reflecting the Stage 1 Competency Standard. • Explicit mapping of educational outcomes to demonstrate adequate level of attainment of the Engineers Australia Generic Attributes.
4.2.2 Titles of program and award	• Titles appropriate to a program of professional engineering education. • Match of title to designated field of practice, program content and specialist focus.
4.2.3 Program structure and implementation framework	• Structure compatible with the delivery of the specified outcomes. • Dual degree pathways providing valid engineering outcomes. • Alternative implementation pathways such as electives, major and minor sequences, cooperative mode, project/thesis options, workplace learning, distance mode and articulation routes providing equivalence of learning outcomes. • Flexible structure adaptable to student backgrounds and individual learning abilities. • Internationalised approach. • Grading of learning experiences over program duration to develop independent learning skills.
4.2.4 Curriculum	Appropriate range, depth, and balance of learning to provide: ENABLING SKILLS AND KNOWLEDGE DEVELOPMENT • Developing underpinning capabilities in: - mathematics, - physical, life and information sciences, - engineering sciences, as appropriate to the designated field of practice • Tackling technically challenging problems from first principles. IN-DEPTH TECHNICAL COMPETENCE • Appropriate range and depth of learning in the technical domains comprising the field of practice - informed by national and international benchmarks. • Application of enabling skills and knowledge to problem solution in these technical domains.

- Meaningful engagement with current technical and professional practices and issues in the designated field.
- Advanced knowledge and capability development in one or more specialist areas through engagement with:
    - the specific body of knowledge and emerging developments,
    - problems and situations of significant technical complexity.

PERSONAL AND PROFESSIONAL SKILLS DEVELOPMENT

- Embedded, cohesive approach addressed by the curriculum as a whole with particular emphasis on developing:
    - an ability to communicate with the engineering team and the community at large,
    - information literacy and the ability to manage information and documentation,
    - creativity and innovation,
    - an understanding of and commitment to ethical and professional responsibilities,
    - an ability to function as an individual and as a team leader and member in multi-disciplinary and multi-cultural teams,
    - a capacity for lifelong learning and professional development,
    - appropriate professional attitudes.

ENGINEERING APPLICATION EXPERIENCE

- Pervasive engineering application activities in technical domains appropriate to the designated field of practice and directed at developing:
    - advanced level skills in the structured solution of complex and often ill defined problems;
    - ability to use a systems approach to complex problems, and to design and operational performance;
    - proficiency in the engineering design of components, systems and/or processes in accordance with specified and agreed performance criteria;
    - skills in implementing and managing engineering projects within the bounds of time, budget, performance and quality assurance requirements;
    - an ability to undertake problem solving, design and project work within a broad contextual framework accommodating social, cultural, ethical, legal, political, economic and environmental responsibilities as well as within the principles of sustainable development and health and safety imperatives;
    - skills in operating within a business environment, organisational and enterprise management and in the fundamental principles of business.

PRACTICAL AND ‘HANDS-ON’ EXPERIENCE

- Embedded experiential learning activities, appropriate to the technical domains within the designated field of practice, and directed at developing:

	- an appreciation of the scientific method, the need for rigour and a sound theoretical basis; - a commitment to safe and sustainable practices; - skills in the selection and characterisation of engineering systems, devices, components and materials; - skills in the selection and application of appropriate engineering resources tools and techniques, appreciation of accuracy and limitations; - skills in the development and application of mathematical, physical and conceptual models, understanding of applicability and shortcomings; - skills in the design and conduct of experiments and measurements; - proficiency in appropriate laboratory procedures; the use of test rigs, instrumentation and test equipment; - skills in recognising unsuccessful outcomes, sources of error, diagnosis, fault finding and re-engineering; - skills in documenting results, analysing credibility of outcomes, critical reflection, developing robust conclusions, reporting outcomes.
4.2.5 Exposure to professional practice	• Exposure to engineering practice (other than formal work placement), used as an integrated learning activity embedded within academic units and contributing in a defined and understood manner to the delivery of graduate capabilities. • Formal work placement requirements documented with appropriate learning outcome targets. • Appropriate systems for recording, tracking and assessing delivery of learning outcomes.

4.3. Quality Systems

Criteria	Performance Indicators
4.3.1 Engagement with external constituencies	• Ongoing, regular input to the establishment and review of outcome targets, educational design and performance assessment from a formal advisory body which includes representation of industry, the community and professional organisations. • External stakeholders facilitating appropriate professional practice exposure opportunities for students. • Productive industry linkages through collaborative project work and research contributing to the professional development of staff and students.
4.3.2 Feedback and stakeholder input to continuous improvement processes	• Use of staff-student consultation forums, focus groups or other direct input mechanisms for on-going review and improvement. • Appropriate use of survey instruments and other means of obtaining systematic feedback. • Graduate, alumni, employer, advisory body and community input mechanisms. • Students as true partners in a culture of continuous quality

	improvement.
4.3.3 Processes for setting and reviewing the educational outcomes specification	• Holistic, outcomes driven approach. • Addressing the full range of graduate capabilities. • Controlled by the generic attributes framework and aligned with the Stage 1Competency Standard. • Specific to each individual program. • Systematic review process inclusive of all teaching staff and the ongoing input from external constituencies. • Ongoing review of benchmark practices, industry needs and demand.
4.3.4 Approach to educational design and review	• Continuous improvement process involving all teaching staff. • Driven by a clear understanding of the 'big-picture' – program objectives and graduate capabilities. • Documented records of improvement processes. • Closing the loop within academic units – learning outcomes - learning activities – assessment. • Systematic mapping of learning outcomes from academic units, aggregating to deliver targeted graduate capability outcomes. • Progressive emphasis on independent learning, reflective practices, critical review, peer and self assessment as the program progresses.
4.3.5 Approach to assessment and performance evaluation	• Integral to the educational design processes. • Adequate range and depth of assessment processes, referenced to relevant standards or benchmarks, including appropriate use of reflective, student self-analysis against targeted learning outcomes and/or graduate capabilities. • Tracking and monitoring the attainment of the full range of graduate capabilities including personal and professional skills and standards of technical competence. • Tracking the performance measures within academic units and how these aggregate to satisfy the capability metrics for the program as a whole. • Rigorous moderation processes. • Systematic review. • Appropriate mechanism for determination of Honours level performance.
4.3.6 Management of alternative implementation pathways and delivery modes	• Adequate processes for analysing, monitoring and ensuring the equivalence of alternative implementation pathways and delivery modes.
4.3.7 Dissemination of educational philosophy	• Adequate documentation of the targeted program outcomes and the educational design philosophy and the associated mapping processes in program • handbooks and records, and/or in individual academic unit guidelines. • Clear mapping of the component contributions from individual academic units to the graduate capability specification. • Clear linkage between learning outcome targets, learning

	activities and performance assessment within the individual academic unit. • Appropriately informing all stakeholders.
4.3.8 Benchmarking	• Appropriate processes for comparing standards of educational outcome targets and performance criteria against the expectations of employers as well as national/international practice.
4.3.9 Approval processes for program development and amendment	• Formal processes for: - new program approval – demand analysis, establishing rationale, outcomes specification, educational design, - - program amendment.
4.3.10 Student administration	• Robust systems for: - student records data management, - individual student progress monitoring, performance warning and exclusion, - student advisory processes, - retention and progression monitoring, - defining and maintaining student admission standards.

5. REFERENCES

1 P02 Engineers Australia Policy on Accreditation of Professional Engineering Programs

2 P05 Engineers Australia National Generic Competency Standards - Stage1 Competency Standard for Professional Engineers

3 G02 Accreditation Criteria Guidelines

4 G06 Preparation of Submission Documentation

Australia, continued:

ACCREDITATION CRITERIA GUIDELINES, Document G02

ENGINEERS AUSTRALIA ACCREDITATION BOARD ACCREDITATION MANAGEMENT SYSTEM

EDUCATION PROGRAMS AT THE LEVEL OF PROFESSIONAL ENGINEER

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Prepared by Professor Alan Bradley, Associate Director, Accreditation.

Authorised by Professor Robin King, Chair of the Accreditation Board.

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1. INTRODUCTION

Engineers Australia, as the National competency authority responsible for the accreditation of professional engineering education programs in Australia, provides a range of documents within its Accreditation Management System. These documents provide a resource for both engineering educators and those responsible for the accreditation function. An index of the documents comprising the Accreditation Management System is provided in Reference 5,

‘Engineers Australia – Accreditation Management System – List of Documents’

This guideline document has been prepared as a supplement to Reference 1 which summarises the key criteria for accreditation. The accreditation criteria provide the basis for evaluation of engineering education programs and also provide, for engineering educators, a resource for the review and development of the teaching and learning environment, for the educational design and review tasks and for the processes of continuous quality improvement.

In this guideline document each criterion is developed more fully to clearly establish the key requirements for compliance and performance expectations.

The accreditation criteria are catalogued under the following section headings and the subsequent discussion is in accordance with this structure:

- Operating Environment
- The Academic Program
- Quality Systems

2. INTERPRETATION OF REQUIREMENTS

In this development of the criteria an attempt has been made to distinguish absolute requirements for accreditation from expected characteristics and performance levels and advice. Again the emphasis is on encouraging innovation and diversity in the educational design, delivery and quality processes. Statements variously employ the words **must** and **should**. Statements containing **must** denote absolute requirements for the program to be accredited. Statements containing **should** are not individually binding but for accreditation to be granted, it is expected that the program will meet a high proportion of them.

3. GUIDELINES TO THE CRITERIA

3.1. The Operating Environment

3.1.1. Identifiable Organisational Structure and Demonstrated Commitment to Engineering Education

There must be an identifiable organisational entity responsible for engineering education within the educational institution awarding the degree. Most commonly this will take the form of a division, faculty or school - a substantial organizational entity providing a key focus on and responsibility for engineering education and scholarship. In documents comprising the Accreditation Management System, the organisational entity responsible for engineering education is referred to as the **engineering school**. Other forms of organisation may be acceptable but it is unlikely, for example, that an engineering program would be accredited if it were taught and managed in isolation by a handful of staff, primarily qualified and practicing in a non-engineering discipline.

It would normally be expected that the engineering school would have leadership responsibility – subject to the approval processes of the host educational organisation– for the educational design, delivery, support and management of the engineering programs, for the management of associated resources, and for the appointment and professional activity of staff. If this is not the case, the educational institution will need to demonstrate how sufficient engineering expertise is brought to bear on decisions in these areas.

The delegated accountability within the engineering school for the management and delivery of each engineering education program should be clearly specified.

There must be evidence that the host educational institution regards engineering education as a significant and long-term component of its activity, and has adequate arrangements for planning, development, delivery, and continuous quality improvement of engineering programs, and for supporting the associated professional activities of staff. This would most commonly be evident from an institution's mission statement and strategic plans, from the approved mission statement and strategic plans of the engineering school, perhaps from corporate responses to engineering school planning submissions or initiatives, and from the outcomes of formal reviews and performance evaluations.

The host organisation must have in place adequate policies and mechanisms for funding its engineering school and facilitating the generation of funds from external sources. Similarly there must be established policy and appropriate practices for attracting, appointing, retaining and rewarding well-qualified staff and providing for their ongoing professional development, and for providing and updating infrastructure and support services. The host institution must ensure that creative leadership is available to the engineering school through the appointment of highly-qualified and experienced senior staff in sufficient numbers.

There must be in place formal structures for the ongoing review and improvement of programs and for formal approval of new program proposals and program amendments.

3.1.2. Academic and Support Staff Profile

The teaching staff must be sufficient in number and capability to assure the quality of the engineering program and the attainment of its stated outcomes. As a guide, a viable engineering school would be expected to have a minimum of eight fulltime-equivalent academic staff employed on a continuing basis, with reasonable gender balance, and would be expected to have not less than three full-time equivalent staff with specialist engineering knowledge and experience in any field in which a designated degree or major is offered. Where a program has little or no overlap with other programs offered, more than three specialist staff members are likely to be necessary.

In no case should a major program be dependent on a single individual.

There should be an acceptable balance of staff appointments across the A – E Academic levels in order to provide appropriate academic leadership and at the same time providing the experience profile, the teaching expertise and student support appropriate to the program.

It is considered important that the staff should come from a diversity of backgrounds, embodying a mix of academic experience and engineering-practice experience in non-academic environments, preferably international as well as Australian. The school's research and/or professional activities should include vigorous interaction with industry and also community interaction.

In gauging the capabilities of staff, the Board will look at qualifications (both in engineering and in education), research and engineering practice activities, teaching experience, and contributions to the advancement of engineering knowledge, practice and education. Involvement in professional societies; chartered status and/or registration on the National Professional Engineers Register and effective participation in on-going professional development are also relevant indicators.

Staff development programs should aim at developing capabilities in educational design, the use of new delivery methodologies and in the development of learning quality management systems as well as professional standing within the specific engineering discipline.

As well as the full-time academic staff team, engineering schools are strongly encouraged to tap the expertise of practising professionals in engineering and related fields for guest lecturing or sessional delivery. There must also be sufficient qualified and experienced members of technical and administrative staff to provide adequate support to the educational program. There must be adequate arrangements for the supervision and guidance of both regular and sessional staff.

The Board will look for evidence that staff numbers and teaching loads are such as to permit adequate interaction with students and support for the range of learning experiences offered, with adequate opportunity available to staff for professional engagement outside of teaching. Arrangements for workload management, capacity and succession planning should support these objectives.

The engineering school and/or the educational institution must have sufficient staff and facilities to provide adequate levels of student counselling, support services, and interaction with relevant constituencies such as employers and graduates.

It is recognised that programs will increasingly be staffed and delivered in a variety of modes. Students will be supported to undertake learning activities at locations other than the 'host' campus through workplace and cooperative learning programs, distance delivery and through offshore arrangements. Educational institutions will form partnerships with both traditional and non-traditional providers to facilitate the delivery of engineering education. The educational institution/s awarding the degree will be considered responsible for assuring the capabilities of all staff involved, and the Board will require evidence of how this is achieved.

Academic staff must be aware of the need to address gender, cross-cultural, inclusiveness and equity issues. Staff development programs should reflect this need.

3.1.3. Academic Leadership and Educational Culture

The Board will look for evidence of a dynamic, innovative and outward-looking intellectual climate in the engineering school. In particular there should be an awareness amongst teaching staff of current educational thinking and development. There should be a pro-active attitude to the adoption of best practice.

There should be significant, ongoing involvement of teaching staff in the processes of setting educational outcome targets, detailed educational design, review and continuous quality improvement. A holistic approach requires for a particular program the full involvement of all teaching staff as a team and this should be evident to students. For each program there should be a clearly identified leader of the teaching team. Terms of reference, accountabilities and reporting obligations for the teaching team and program leader should be clearly defined and understood by all stakeholders.

The teaching team would be expected to meet regularly to consider input and feedback from the full range of constituencies, and use this in the on-going improvement of detailed learning strategies, structure, curriculum content and delivery. The teaching team should monitor, using declared performance criteria, the attainment of the targeted educational outcomes for the program as a whole as well as the delivery of the learning outcomes within individual academic units.

Staff should actively role-model the competencies defined in the appropriate National Generic Competency Standard and should be continually aware of their responsibility to do so.

Staff appointment, staff development, management and codes of practice in the school and the institution should address cultural, gender and equity issues and reflect an inclusive operating environment.

Through policy and operating practices there should be clear acknowledgment of the need to interlink research, industry and community interaction with teaching to enrich the experiences of students and facilitate the on-going professional development of staff.

3.1.4. Facilities and Physical Resources

For both on-campus and external students alike there must be adequate classrooms, learning-support facilities, study areas, library and information resources, computing and information-technology systems, and general infrastructure to fully support the achievement of the targeted learning outcomes for each specific program.

For all programs and associated implementation pathways, there must be adequate facilities for student-staff interaction. For distance, remote campus or offshore implementations there must be communication facilities sufficient to provide students with learning experiences and support equivalent to on-campus attendance.

Appropriate experimental facilities must be available for students to gain substantial experience in understanding and operating engineering equipment, of designing and conducting experiments and undertaking engineering project work. The equipment must be reasonably representative of modern engineering practice and facilitate sound learning design. Facilities need to support structured laboratory activities, experiments of an investigatory nature and more open ended project based learning. Access to modern analysis, synthesis, visualisation, simulation, planning, organisational and measuring tools in the engineering, sciences, business, communication and management domains is expected.

Where practical work is undertaken remote from the host campus, such as at another educational institution or in an industry environment, the arrangements must be such as to provide appropriate facilities, supervision and equipment access and an assured equivalence of learning outcomes.

Facilities and equipment access must be supportive of the development of the full range of educational outcomes defined for a specific program and allow students to explore beyond the formal dictates of the particular discipline of study where appropriate.

3.1.5. Funding

The funds provided through the host organisation, from all sources including government grant funds, fee income, and direct income earned through research and entrepreneurial activity, must be sufficient to adequately support the current engineering education programs and satisfy the resource aspects of the accreditation criteria. The strategic planning cycle and funding distribution models must ensure predicable levels of support and the on-going viability of the engineering programs/s.

3.1.6. Strategic Management of Student Profile

Resources provided to the engineering school are frequently dependent on student numbers. A criterion for viability is therefore a continuing level of demand for admission from adequately-qualified candidates in sufficient numbers to maintain the program. On-going viability should be monitored through rigorous demand analysis. Strategic decisions on program offerings should be taken systematically and on an appropriate time scale.

The admission system must adequately publicise the qualifications required for entry and ensure that only qualified candidates are admitted. Where advanced standing is offered, there must be clearly defined and rigorous processes for the analysis, assessment and verification of prior learning. The engineering school should be able to demonstrate a reasonable relationship between admission standards and student retention and graduation rates.

Determination of Honours must be based on a sound performance analysis rationale and reflect a standard of excellence commensurate with the performance criteria embedded within the educational outcomes specification and external benchmarks.

3.2. The Academic Program

3.2.1. Specification of Educational Outcomes

To ensure that a systematic approach is taken for the balanced development of graduates, each program submitted for accreditation must be supported by a published specification of educational outcomes tailored to the particular field(s) of practice and associated area(s) of specialisation. The educational outcomes specification should justify the inclusion or omission of any specialist title. External stakeholder input is critical to the development, review and attainment monitoring of these outcomes.

The Engineers Australia National Generic Competency Standards – Stage 1 Competency Standard for Professional Engineer (Reference 3) provides a detailed generic description of the expected knowledge, capabilities and attributes expected of the graduate engineer. The Competency Standard builds on and assures delivery of the original and brief generic attributes statement specified in the Accreditation Policy.

The Competency Standard develops detailed elements of competency and indication of performance under the headings of Knowledge Base, Engineering Ability and Professional Attributes. It provides an ideal, generic template or model for building a detailed educational outcome specification, customised for a particular education program in a nominated field of engineering practice. The educational outcomes specification should include a statement of broad educational objectives as well as targeted graduate capabilities for the program in the specified field. The rationale for the specification of outcomes should be founded on the needs of industry and the community, trends in professional practice and comparisons with programs of similar nature available nationally or internationally.

The statement of educational objectives should relate to the mission of the host institution and reflect the specialist technical focus, the anticipated career destinations of graduates, and the needs of appropriate external constituencies.

The educational objectives statement would also be expected to reflect the desired characteristics and/or capabilities and/or achievements of mature graduates within the first few years of their career following graduation. It also needs to be appropriate within a broad definition of engineering - a profession trusted by society for conceiving, designing, implementing, maintaining, managing and ultimately disposing of infrastructure, products, processes and services within broad contextual criteria.

The targeted capabilities for emerging graduates should be consistent with the Stage 1 – Competency Standard. Technical skills and knowledge and engineering application skills appropriate to the designated field of practice and/or specializations should be clearly specified, supplementing the generic capabilities and attributes that are relevant to all fields of practice.

Targeted graduate capabilities should demonstrate a balanced and integrated development of enabling skills and knowledge, technical competence and engineering application skills along with personal and professional capabilities. Appropriate breadth and depth of competence must be clearly demonstrated in the technical domains comprising the field of practice and through high level knowledge and skills in nominated specialist areas.

Each graduate capability target should ideally include measurable performance indicators to provide a basis for monitoring the level of attainment. The multidimensional performance metric in each case is likely to involve quantitative and qualitative measures with inputs from a range of sources. Such measures would draw considerably on formal assessment processes from within academic units as well as from the feedback and direct input of various constituencies.

The specification of educational outcomes should provide a platform for subsequent educational design and review tasks and provide a key reference for tracking the aggregation of learning outcomes and assessment measures from individual academic units comprising the program.

3.2.2. Titles of Program and Award

To be eligible for accreditation, a program must include the word *engineering* in its title and, unless the circumstances are exceptional, must lead to a degree which includes *engineering* in its title.

A professional engineering program must aim to deliver graduates with capabilities appropriate to a designated field of engineering practice. This will most commonly be reflected in the title of the program and/or degree, or cited as a major field of study in the academic transcript. It is not essential however for any nominated specialisation to appear in the title. The key requirement is that the program engages students with a coherent area of engineering providing an appreciation of current technical issues and developing competence in handling advanced technical problems.

Where a title denotes specialisation in a particular field of practice, the program must impart high level technical skills and knowledge in that specialisation. A program that omits coverage of substantial topics in the field implied by the title, in which a professional in that field could reasonably be expected to have competence, should not be accredited.

New program titles may be expected to arise in response to evolving industrial and professional practice (for example, as set out in the listings of engineering disciplines published from time to time by Engineers Australia and elsewhere). Programs may draw on several existing fields of specialisation, and may incorporate new knowledge or the application of knowledge in new practice environments. The Board does not wish to be prescriptive about titles, nor does it wish to encourage a proliferation of specialist titles that may have transitory lifetimes. It reserves the right to query a title or field of practice which it regards as inappropriate, or to decline to accredit.

Some of the fields of practice and specialisations already recognised in the titles of accredited programs are listed in Reference 2.

3.2.3. Program Structure and Implementation Framework

The normal requirement of an accredited professional engineering program in Australia is four years of full-time-equivalent study, based on entry from a satisfactory level of achievement at Higher School Certificate level (twelve years of primary and secondary schooling) or equivalent. Programs offered via alternative implementation pathways (elective units and study sequences, workplace learning options, defined articulation routes, part-time attendance, distance mode, offshore and remote campus) must be demonstrably equivalent in terms of content, in the delivery of graduate outcomes as well as in the learning expectations of students.

The conventional academic year involves two semesters of formal study and examination, offering apparent scope for accelerated-progression utilising the remainder of the calendar year. In considering any program that offers completion in significantly less than four years, the Board will wish to be assured that it provides adequate opportunity for personal and professional skills development and the full equivalence of defined outcomes.

Program durations exceeding the normal four years of full time study may be appropriate in some circumstances. Assessment will always be based on the assumed delivery of an appropriate standard of graduate outcomes, commensurate with the generic frame work of the Stage 1 Competency Standard and appropriate to the designated field of practice.

The curriculum must comprise an integrated set of tasks and structured learning experiences that lead to the delivery of the specified educational outcomes, and by implication, satisfactory attainment of the generic attributes. The necessary opportunities and support mechanisms must be provided.

The program structure must be appropriate to the development of in depth technical competence in the designated field of practice and in nominated specialist areas.

In accordance with the Accreditation Policy, a professional engineering program would be expected to include the following elements, the percentages denoting indicative proportions of the total learning experience measured in terms of student effort:

- mathematics, science, engineering principles, skills and tools appropriate to the discipline of study (not less than 40%),
- engineering design and projects (approximately 20%),
- an engineering discipline specialisation (approximately 20%),
- integrated exposure to professional engineering practice, including management and professional ethics (approximately 10%),
- more of any of the above elements, or other elective studies (approximately 10%).

These proportions are not mutually exclusive. Some relate principally to content, and others relate more to learning processes. A particular learning activity may consist of several of these component elements. Likewise a particular learning activity may concurrently contribute to various educational outcomes ranging through personal/professional, problem solving/design, enabling and specialist technical categories.

Substantial departure from these elemental proportions must be justified as consistent with the targeted educational outcomes for the program and thus the attainment of the generic attributes.

The structure should be sufficiently flexible to provide for any variance in the background and prior learning of students as well as for the differences in individual learning ability. The program structure must accommodate the curriculum requirements specified in section 3.2.4 below and should facilitate an integrated approach to:

- developing enabling skills and knowledge,
- developing in depth technical competence,
- providing practical and laboratory learning, problem solving design and project based learning,
- developing personal and professional capabilities,
- exposing students to professional engineering practice.

The structure should also promote a graded transition of learning experiences from a structured beginning to a more independent learning approach as the program progresses.

A holistic approach to educational design will ensure that the individual learning outcomes and performance measures within each academic unit aggregate systematically to deliverer the educational outcomes targeted for the overall program.

3.2.3.1. Combined / Dual / Double Degrees

Increasing numbers of programs take the form of combined or dual or double degrees, combining an engineering outcome within a nominated specialist field with a second outcome in either another discipline altogether or in a second specialist field of engineering. In most instances, two individual degree testamurs are awarded, but sometimes a combined outcome is specified on a single testamur. Typically, the dual program occupies substantially less time than would the two degree programs taken separately. This is achieved by identifying content and learning experiences which may validly be counted towards both qualifications.

In all cases, for the accreditation of each professional engineering program the Board will require the present policy and criteria to be met and demonstrated in full. The representative proportions of the learning experience, cited above, are to be interpreted as proportions of four full-time years, or their equivalent in other modes.

Where a combined / dual/ double degree program comprises two separate engineering outcomes, each in a designated specialist field, the policy and criteria must be satisfied for each individual outcome. Obviously there will be common development of some of the enabling skills and knowledge, as well as personal and professional capabilities, but for each of the two degree outcomes there will need to be evidence of the development of the appropriate depth of technical skills and knowledge, design and problem solving capability and appropriate exposure to professional practice in the respective specialist field.

3.2.3.2. Alternative Implementation Pathways

Flexible delivery options are usually implemented as alternative implementation pathways within a single program definition. Such pathways can range from alternative academic units selected from a list of electives for a student studying on the home campus, major and minor elective sequences, optional cooperative modes, project and/or thesis options, workplace learning options, distance modes and various articulation routes right through to an offshore implementation of the program.

The program structure must accommodate such alternative pathways in such a way as to assure the equivalence of educational outcomes for every individual student. Reference 4 discusses in further detail the accreditation of alternative implementation pathways.

The early stages of the program should be tailored to the backgrounds of commencing students and should provide appropriate pathways for each group admitted. This should include special support programs for students admitted from disadvantaged or unconventional backgrounds, or with language difficulties.

3.2.4. Curriculum

The educational design and review process should be directed at an integrated curriculum delivering a balance of enabling or underpinning knowledge and skills, technical competence, engineering application skills and personal and professional capabilities. The curriculum must provide for the delivery of these outcomes in accordance with the requirements and explicit learning experiences specified below.

3.2.4.1. Enabling Skills and Knowledge Development

Enabling skills and knowledge in mathematics; physical, life and information sciences, and in engineering fundamentals must adequately underpin the development of high level technical capabilities, and engineering application work within the designated field of practice and selected specialisation(s).

Graduates should have an ability to work from first principles in tackling technically challenging problems.

3.2.4.2. In Depth Technical Competence

Engineering schools must make decisions on the breadth and depth of technical content within the technical domains comprising the field of practice and selected specialist areas as part of the educational design process. These decisions will be guided by external advisory mechanisms, benchmarking, and resources such as guidelines provided by professional engineering bodies.

Graduates generally should have knowledge of the major technical areas comprising the field of practice and competence in applying mathematics, science and engineering science to the analysis and solution of representative problems, situations and challenges in those areas.

Graduates should have knowledge of materials and resources relevant to the field of practice, and their main properties, and ability to select appropriate materials and techniques for particular objectives.

Students should be confronted with current technical and professional practices as well as critical and emerging issues within the designated field of practice.

Advanced knowledge and capability development in one or more specialist areas should be achieved through in-depth engagement with the specific body of knowledge and emerging developments and with problems and situations of significant technical complexity.

Graduates should have an ability to ensure that all aspects of a project or program are soundly based in theory and fundamental principles and to recognise results, calculations or proposals that may be ill-founded, identify the underlying source and nature of the problem and take corrective action.

Graduates should also have an understanding of how new developments relate to established theory and practice and to other disciplines with which they interact.

The Board will look for evidence that the technical knowledge and skill targets are commensurate with the range and depth expected by employers and consistent with international practice. The accreditation process will evaluate the steps taken in setting outcome targets such as the educational design process, the curriculum, the learning activities and student assessment processes in judging the adequacy of technical depth.

3.2.4.3. Personal and Professional Skills Development

The development of personal and professional skills should be addressed by the curriculum as a whole. An integrated and pervasive educational design approach will map the development of these skills through a wide range of learning activities spread throughout all stages of the program. The following list of personal and professional attributes along with associated performance and range indicators has been extracted from the Engineers Australia National Generic Competency Standards - Stage 1 – Competency Standard for Professional Engineer (Reference 3)

Ability to communicate with the engineering team and the community at large and evidenced by:

- competence in written and spoken English;
- an ability to make oral and written presentations to technical and non-technical audiences;
- a capacity to hear and comprehend others' viewpoints as well as disseminate information;
- effective discussion, debating and argument presentation skills;
- an ability to effectively represent the engineering profession to the community.

Information literacy and ability to manage information and documentation, demonstrated by:

- an ability to systematically and effectively source, analyse, evaluate and catalogue relevant information;
- an ability to assess the accuracy, reliability and authenticity of information;
- an ability to communicate through engineering drawings and sketches;
- fluency in the use of computer based communication and document preparation tools;
- skills in the creation, management and control of documents;
- skills in maintaining professional journals and records;
- skills in the preparation of progress reports, project reports, reports of investigations, proposals, designs, briefs and technical directions.

Creativity and innovation skills demonstrated by:

- a readiness to challenge technical practices from a non-technical viewpoint to identify opportunities for improvement;
- applying creative approaches to identify and develop alternative concepts and procedures;
- an awareness of other fields of engineering and technology with which interactions may develop and an openness to such interactions;
- seeking information from the widest practicable range of sources;
- engaging in wide ranging exchanges of ideas and being receptive to change.

Understanding of and commitment to ethical and professional responsibilities, including:

- Engineers Australia code of ethics;
- relevant legislation and statutory requirements;
- codes of practice and standards relevant to the field of engineering practice;
- sustainable and safe practices;

with:

- values, attitudes and conduct reflecting a social, cultural and environmental awareness.

Ability to function as an individual and as a team leader and member in multi-disciplinary and multi-cultural teams, and demonstrated by:

- managing time and processes and prioritising competing demands;
- achieving trust and confidence of colleagues through competent and timely completion of tasks;
- professional interaction with peers and other professionals to achieve a collective outcome;
- recognising the value of diversity, interpersonal and inter-cultural skills and effective network relationships that value and sustain a team ethic;
- mentoring others and the acceptance of mentoring;
- a capacity for initiative and leadership whist respecting others' agreed roles.

Capacity for lifelong learning and professional development, demonstrated by:

- recognising personal limits to knowledge and competence, seeking advice and undertaking research to supplement knowledge and experience;
- taking charge of own learning and development, self review and reflection, inviting peer review, personal benchmarking, identifying areas for personal development;
- developing a propensity to seek out, comprehend and apply new information;
- a commitment to the importance of being part of a professional and intellectual community: learning from its knowledge and standards, and contributing to their maintenance and advancement;
- building non-engineering knowledge and skills to assist in achieving engineering outcomes.

An appropriate professional attitude as evidenced by:

- presenting a professional image in all circumstances;
- a capacity for intellectual rigour and a readiness to tackle new issues in a responsible manner;
- demonstrating a sense of the physical and intellectual dimensions of projects and programs, and related information requirements, based on reasoning from first principles and on developing experience.

3.2.4.4. Engineering Application Experience

Engineering application activities should be pervasive to the curriculum and include complex problem solving, design and project work. It is expected that programs will embody at least one major engineering project experience, which draws on technical knowledge and skills, problem solving capabilities and design skills from several parts of the program and incorporate broad contextual considerations as part of a full project life cycle. Students should engage with complex, open-ended problems and work in both individual and team capacities. The curriculum should also develop engineering design capability, appropriate to the field of practice. Ideally a program will contain multiple design tasks, research and project activities spread throughout the various levels.

Engineering application work should be representative of the field of practice and include technical and non-technical considerations. A key objective should be to develop an appreciation of the interactions between technical systems and the social, cultural, ethical, legal, political, environmental and economic context in which they operate.

The following lists some of the expected features and outcomes of engineering application activity.

Complex problem identification, formulation and solution

- Identifying the nature of a technical problem, making appropriate simplifying assumptions, achieving a solution and quantifying the significance of the assumptions to the reliability of the solution.
- Systematic investigation of a situation - ascertaining relevant causes and effects.
- Identifying potential engineering contributions to situations requiring multidisciplinary inputs.
- Addressing problems with no obvious solution and the coping with the need for originality in analysis.

Systems engineering approach

- Addressing problems and situations with ill defined, uncertain and potentially conflicting factors.

- Planning and quantifying performance over a project lifecycle integrating technical and non-technical outcomes.
- Partitioning a problem, process or system into manageable elements and recombining to form the whole.
- Conceptualise, defining and evaluating possible alternative solution strategies.
- Comprehending, assessing and quantifying risks and devise strategies for their management.
- Selection and justification of an optimal approach.
- Employing feedback from commissioning and operational performance in the continuing improvement cycle.

Engineering design

- Application of technical knowledge, design methodology, and appropriate tools and resources to design devices, components, systems, facilities or processes to meet desired needs and specified performance criteria within realistic contextual constraints.
- Developing competence in:
  - writing/interpreting functional specifications;
  - seeking advice from appropriate sources;
  - identifying and analysing design concepts and choice of solution;
  - ensuring chosen solution maximises functionality, safety and sustainability imperatives;
  - applying appropriate engineering principles, resources and processes to the design task;
  - complying with appropriate standards and codes of practice;
  - ensuring integration of all functional elements;
  - validating the design solution against the engineering and functional specifications;
  - ensuring that all proposals and designs emphasise reliability, manufacturability, maintainability, cost-effectiveness, product quality and value, and user friendliness.

Implementing and managing projects

- Developing skills in:
  - project scoping and dimensioning;
  - planning outcomes, quantifying performance requirements, developing acceptance criteria;
  - identifying quantifying and managing risks, impacts and constraints;
  - developing specifications, referencing appropriate engineering methods, standards and codes of practice;
  - identifying, considering and evaluating alternative solution approaches;
  - developing a formal design proposal optimising functionality, cost effectiveness and reliability as well as satisfying sustainability targets and health and safety imperatives;
  - applying technical knowledge, design methodology, tools and resources to design devices, components, systems, facilities or processes;
  - integrating functional elements to form a coherent, self consistent system;
  - quantifying engineering tasks, facilities and resources to implement a solution over the full project cycle;
  - implementing the build or construct cycle to realise or prototype the design solution;
  - devising a test regime to verify performance and take any necessary corrective action;
  - formal project management; and
  - record keeping, reporting, presentation and documentation of outcomes.

Operating in a broad contextual framework

- Developing an ability to:
  - appreciate the interactions between technical systems and the social, cultural, environmental, ethics, economic, legal, health and safety, and political contexts;
  - appreciate the imperatives of safety and of sustainability;
  - interact with people in other disciplines and professions and to ensure the proper integration of any engineering component in a multi-disciplinary project;
  - appreciate the nature of technical risk and also risk to clients, users, the community and the environment.

Appreciation of the business environment and the development of fundamental business and management skills

- Business skills development should be within an engineering practice framework and embrace:
  - the overall conduct and management of business enterprises and the structure and capabilities of the engineering workforce;
  - the commercial, financial, legal and marketing aspects of engineering projects and the requirements for successful innovation;
  - fundamental business principles and their significance;
  - cost consideration throughout a design or project and the task of managing within realistic constraints of time and budget.

3.2.4.5. Practical and 'Hands-On' Experience

There must be substantial hands-on practical experience manifested through specifically designed laboratory activities, investigatory assignments and project work. The specific learning contributions from practical work should be thoroughly understood, mapped and documented as an integral part of the learning design process within any particular academic unit. Practical learning experiences should engage students with the use of facilities, equipment and instrumentation reflective of current industry practice.

The learning outcomes from laboratory and other practical learning activities should aim to include the development of:

- an appreciation of the scientific method, the need for rigour and a sound theoretical basis;
- a commitment to safe and sustainable practices;
- skills in the selection and characterisation of engineering systems, devices, components and materials;
- skills in the selection and application of appropriate engineering resources tools and techniques;
- skills in the development and application of models;
- skills in the design and conduct of experiments and measurements;
- proficiency in appropriate laboratory procedures; the use of test rigs, instrumentation and test equipment;
- skills in recognising unsuccessful outcomes, diagnosis, fault finding and reengineering;
- Skills in perceiving possible sources of error, eliminating or compensating for them where possible, and quantifying their significance to the conclusions drawn;

- skills in documenting results, analysing credibility of outcomes, critical reflection, developing robust conclusions, reporting outcomes.

3.2.5. Exposure to Professional Practice

Exposure to professional engineering practice is a key element in differentiating a professional engineering degree from an applied science degree. Although the status of Chartered Professional Engineer requires a substantial period of experiential formation in industry after graduation, it is clearly unsatisfactory for the student's perceptions of engineering to develop, over the first four critical years, in complete isolation from the realities of practice. There is obvious benefit in ensuring that at least an element of professional formation is interwoven with the academic curriculum, to provide a balanced perspective and relate academic preparation to career expectations.

Professional practice exposure must be considered as an integral learning activity within the educational design process and make a significant and deliberate contribution to the delivery of educational outcomes. The objectives associated with each major episode of exposure need to be clearly understood by all constituencies and documented as a formal learning activity within a designated academic unit. There must be defined contributions from these activities to the specific learning outcomes of academic units and in turn to the educational outcomes of the program as a whole.

There should be a formalised tracking, monitoring and assessment of the learning outcomes associated with professional practice exposure. This may for example be through a journal or portfolio system where students record and reflect on their experiences against the targeted graduate capabilities set for the program.

Professional engineering practice exposure must include some of the following:

- use of staff with industry experience,
- practical experience in an engineering environment outside the teaching establishment,
- mandatory exposure to lectures on professional ethics and conduct,
- use of guest presenters,
- industry visits and inspections,
- an industry based final year project,
- industry research for feasibility studies,
- study of industry policies, processes, practices and benchmarks,
- interviewing engineering professionals,
- industry based investigatory assignments,
- direct industry input of data and advice to problem solving, projects and evaluation tasks,
- electronic links with practising professionals, and
- case studies.

It is considered that there is no real substitute for first-hand experience in an engineering- practice environment, outside the educational institution. Engineers Australia strongly advocates that all engineering schools include a minimum of 12 weeks of such experience (or a satisfactory alternative) as a requirement for the granting of qualifications, in addition to the other elements suggested, and make strenuous effort to assist all students to gain placements of suitable quality. However it is recognised that this may not always be possible.

The requirement for accreditation is that programs incorporate a mix of the above elements, and others – perhaps offering a variety of opportunities to different students – to a total that can reasonably be seen as equivalent to at least 12 weeks of full time exposure to professional practice in terms of the learning outcomes provided.

In the same way as for other modes of learning, submitted documentation must explain how the various dimensions of professional practice exposure contribute to the overall educational design. Where practice exposure is incorporated within the four-year equivalent curriculum, it must embody assessable requirements comparable with other curriculum elements that attract similar credit. Where it consists of work experience in industry, not otherwise formally assessed, it should be counted in addition to the four-year academic requirement.

3.2.5.1. Cooperative and Workplace Learning

Some educational institutions offer programs in which students are required to gain substantial practical experience in industry, or other engineering-practice settings and interspersed with the academic program. These are generically known as cooperative education programs, involving cooperation between the education provider, the student, and one or more engineering employers.

Cooperative education programs would normally include the following features:

- an engineering-practice experience requirement taken in periods of sufficient duration for substantial work to be undertaken, and completed prior to the final academic semester;
- stated and assessed learning outcomes from this element of engineering practice experience;
- a formal requirement that the engineering practice experience be completed to a satisfactory standard, as a prerequisite for the award of the degree;
- comprehensive documentation of these requirements and how they are met;
- an office providing assistance to students in finding suitable practice experience placements.

The Board acknowledges these programs, and accredits them in the same way as any other professional engineering program.

3.3. Quality Systems

Appropriate policy, processes and practices must be in place at all levels within the educational institution to assure the quality of engineering education. The dimensions of the educational quality system must embrace the following components.

3.3.1. Engagement with External Constituencies

Valid preparation of students for professional engineering practice requires interaction with industry on a continuing basis. There have been many messages from industry, often at the highest levels, that educational institutions have insufficient appreciation of the real needs of employment and must learn the real-world lessons of fitness for purpose, quality assurance and continuous interaction with clients. In short, education providers must “get closer to industry”. Engineering schools are responding seriously to these injunctions, and the Accreditation Policy requires that they should. For the response to be effective, industry must make a serious commitment to the partnership in return.

Some companies are exemplary in this regard; many more are needed for the relationship to be fully realised.

A specific requirement of the Policy is a formally-constituted advisory mechanism or mechanisms, involving program constituencies generally and industry in particular. The engineering school must secure the active participation of practicing professional engineers, graduates, professional bodies and leading employers of engineering graduates in defining, updating and evaluating educational outcomes for each program.

At least some members of the advisory body should be at senior level. In order for such involvement to be effective, the interactions must be well structured and well managed. The engineering school must present real issues for debate and must be seen to be responsive to comments made. Consultative dialogue should be bilateral or multilateral, involving active contributions and making use of the expertise of all constituent groups including students.

A senior industry advisory body would be mainly expected to operate at the strategic level in monitoring and analysing industry needs and trends as well as in the review and performance monitoring of the program objectives and graduate capability targets. The advisory body should have input to establishing performance standards and strategies for monitoring the development of technical competence, engineering application skills and personal and professional skills for each particular program. Depending upon organisation structures, there may be a case for a two tiered approach, to provide both strategic direction and advice as well as specific input to the educational design, review and performance monitoring at the individual program level. In some instances this may be achieved by a single advisory body with individual members or sub-groups accepting engagement to provide advice and assistance in learning design at a more detailed, operational level. Individuals may well also serve as adjunct staff or assessors of student performance.

An effective and productive industry engagement is also crucial for providing students with the necessary range of exposure to professional engineering practice as well as providing opportunity for collaborative project work and the professional development of staff.

3.3.2. Feedback and Stakeholder Input to Continuous Improvement Processes

There must be formal processes for securing specific and systematic feedback from constituencies such as students, graduates, employers of engineers and representatives of the wider community. There should be evidence of the systematic application of feedback in conjunction with other quantitative measures to setting, monitoring and reviewing outcomes at program and academic unit level.

Direct involvement of the student body as partners in the processes of continuous quality improvement is strongly encouraged. Staff-student consultation forums, focus groups and commissioned submissions can facilitate productive involvement as well as providing direct educational experiences for the student in the processes of quality assurance.

External stakeholder feedback and input should provide an important dimension in monitoring the delivery and attainment of program objectives and graduate capability targets.

3.3.3. Processes for Setting and Reviewing the Educational Outcomes Specification

There should be formal, documented processes for setting and reviewing the detailed educational objectives and graduate capability targets for each program as a whole. Reviews should be regular and on-going. These processes should ensure that the outcomes specification remains aligned with the Engineers Australia Stage Generic Competency Standards – Stage 1 Competency Standard for Professional Engineers – (Reference 3), as well as external practices and specific industry needs. The specification of targeted graduate capabilities should cover enabling skills and knowledge, depth and breadth of technical competence, engineering application skills, as well as personal and professional capabilities. The Stage 1 Competency Standard provides a useful generic template for such an outcomes specification to which would need to be added technical outcomes appropriate to the designated field of practice and/or specialisation(s).

Systematic review processes should be inclusive of all staff engaged in the delivery of the program, and involve the on-going input of external constituencies as well as feedback and input from the student body.

3.3.4. Approach to Educational Design and Review

A systematic and holistic approach to educational design, review and continuous quality improvement must be evident.

Beginning with the specification of educational objectives and targeted graduate capabilities, a structured, 'top-down' approach to learning design should next determine the specific and measurable learning outcomes for each academic unit within the program.

At the academic unit level, the learning design process should continue by developing the appropriate learning activities and the formative and summative assessment approaches which monitor and measure the delivery of the learning outcomes. Closing the loop on learning outcomes, learning activities and assessment measures at the academic unit level should be a prime objective.

A mapping of the learning outcomes from individual academic units to the targeted graduate capabilities for the program as a whole should be a prime reference tool emerging from this process and underpin the outcomes based educational design. Subsequently, tracking this aggregation of learning outcomes and assessment measures from individual academic units to close the loop on delivery of graduate capabilities at the program level is a key component of the on-going review and improvement process.

Again, the educational design, review and continuous quality process should be inclusive of all program teaching staff through regular interactions, and involve the on-going input and feedback of the student body. Performance assessment at every level should involve a variety of measures as well as input from an appropriate range of stakeholders and drive the improvement cycle.

The overall goal of the learning design process is to ensure that the curriculum as a whole addresses the educational outcomes set for the program in a substantial, coherent and explicit way, emphasising contextual relationships. For example, in relation to communication skills development, it would not be sufficient to expect an adequate skill level to be established within one or two dedicated academic units at particular points in the program. Nor would it be sufficient to say that all or most of the academic units involve communication in one form or another, and no further explicit attention is necessary. As well as a pervading expectation of good communication practices, there should be a series of structured exercises (such as team projects and outreach activities) expressly requiring effective communication of an advanced order and using engineering issues as the vehicle, both at technical level between engineers, and at non-technical level with other professionals or with the community generally. Such exercises should involve both conveying complex intelligence, and receiving and responding to it. Multiple opportunities should be provided, for students with different temperaments and backgrounds.

3.3.5. Approach to Assessment and Performance Evaluation

The development of assessment and performance monitoring systems must be an integral part of the overall educational design process for any particular program.

There should be evidence that the assessment tools and evaluation processes within individual academic units are rigorously aligned with the designated learning outcomes for the unit.

At program level, assessment measures from within individual academic units along with a range of inputs, feedback and performance measures gleaned from the full range of constituencies will come together to provide multi-dimensional data appropriate for evaluating performance against the standards set for each of the targeted educational outcomes. Substantiating delivery of the prescribed outcomes in this way will validate satisfactory attainment of the Stage 1 competencies and thus ensure that the generic attributes specified in the Accreditation Policy are developed to a sufficient degree in all graduates.

Summative and formative assessment tools may include examinations, tests, quizzes, project reports, self, peer, and mentor appraisals, portfolios and journals, oral examinations and interviews and behavioural observations. Other sources of performance data at both the level of academic unit and for the program as a whole will include surveys, focus and discussion groups, questionnaires and professional interviews. Collectively these widespread measures will provide the inputs for performance evaluation and monitoring delivery of outcomes at all levels.

It is important that students be required to perform in at least one (and preferably several) assessable situations involving major and wide-ranging challenges, drawing on knowledge and capability from different subject areas.

There should be a documented system for setting, reviewing and monitoring the delivery of learning outcomes associated with professional practice exposure.

The assessment regime should address the full range of graduate capabilities, including personal and professional skills development.

A rigorous moderation process should be in place to monitor and manage the assessment processes within academic units.

The processes for determination of honours should be clearly documented, and assure the performance standards of honours graduates is comparable with benchmark practice standards.

3.3.6. Management of Alternative Implementation Pathways and Delivery Modes

There must be rigorous processes for monitoring and managing alternative implementation pathways within a particular program definition, and for assuring the equivalence of educational outcomes for the program as a whole. Such alternative implementation pathways will range from specialised entry routes and elective academic units within an established home campus program right through to an offshore or remote campus offering of such a program.

3.3.7. Dissemination of Educational Philosophy

The educational design process should be properly documented and made available in appropriate form to each category of stakeholder. For students enrolled in a particular academic unit, this would mean a clear description of expected learning outcomes for the unit, the way in which learning activities will contribute to achievement of these outcomes and how performance against the target outcomes will be assessed. In addition such documentation should demonstrate how the academic unit learning outcomes are tracked to ensure these aggregate systematically to deliver the overall educational outcomes specified for the program. Dissemination of this holistic view of the educational design would normally be through published academic unit learning guides.

Systematic documentation of the educational design is crucial as educational institutions consider alternative implementation pathways to cover initiatives such as distance, workplace, cooperative and offshore delivery options and to provide for recognised articulation routes. Formalised mapping of unit learning outcomes against the targeted educational outcomes of a program and thorough learning design at the academic unit level provides an elemental breakdown of the learning processes. Such a breakdown facilitates the task of establishing the equivalence and validity of alternative implementation pathways. Examples could be the consideration of prior or concurrent learning in an industry setting or arguing the validity of alternatives to the traditional laboratory learning offered at a home campus.

3.3.8. Benchmarking

Engineering schools should engage in some form of comparative analysis to ensure that exit-level performance standards are comparable with national practice, and preferably international practice for the full range of graduate capabilities. Comparative analysis could include exchanges of teaching and assessment materials, discussion forums, visitation teams and/or the use of external examiners, if so desired. Beyond this, more systematic benchmarking could help in identifying best practices and specific directions for improvement. The accreditation process will evaluate program standards, but education providers should do so as part of the process of setting the performance criteria and monitoring targeted graduate outcomes, and not rely on the accreditation system for this.

3.3.9. Approval Processes for Program Development and Amendment

There must be formal approval processes associated with program and curriculum planning and review, with due reference to demand analysis, the input of external constituents, and quality management processes.

3.3.10. Student Administration

There must be an admissions system that ensures an acceptable standard of entry for students from appropriate educational backgrounds. There must be policies and processes for the acceptance of transfer students, validation of formal prior learning and analysis of prior learning or concurrent learning in non-formal settings.

The admission system must adequately publicise the qualifications required for entry and ensure that only qualified candidates are admitted. There should be formal policies and processes for tracking student progress, issuing advice and the provision of timely warnings to students at risk, systematic remediation, exclusion and appeal.

The records management system must enable auditing of the above processes at any time and provide confirmation of integrity.

(3) IRELAND

PART 1: EDUCATION STANDARD REQUIRED FOR REGISTRATION OF CHARTERED ENGINEERS

1.1 Definition of a Chartered Engineer

The following is the definition of a professional engineer recognised by the Council of Engineers Ireland for the title Chartered Engineer and is the definition adopted in 1960 by the Conference of Engineering Societies of Western Europe and the United States of America (EUSEC):

A Chartered Engineer is competent by virtue of his/her fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He/she is able to assume personal responsibility for the development and application of engineering science and knowledge, notably in research, design, construction, manufacturing, superintending, managing and in the education of the engineer. His/her work is predominantly intellectual and varied and not of a routine mental or physical character. It requires the exercise of original thought and judgement and the ability to supervise the technical and administrative work of others.

His/her education will have been such as to make him/her capable of closely and continuously following progress in his/her branch of engineering science by consulting newly published works on a worldwide basis, assimilating such information and applying it independently. He/she is thus placed in a position to make contributions to the development of engineering science or its applications.

His/her education and training will have been such that he/she will have acquired a broad and general appreciation of the engineering sciences as well as a thorough insight into the special features of his/her own branch. In due time he/she will be able to give authoritative technical advice and to assume responsibility for the direction of important tasks in his/her branch.

1.2 Formation of a Chartered Engineer

The formation of a Chartered Engineer takes a minimum of eight years and consists of two phases. The first phase consists of studying and successfully completing an engineering degree programme accredited by Engineers Ireland as meeting the education standard required for the title Chartered Engineer. The second phase is called Initial Professional Development and generally involves the achievement of the competences necessary to apply engineering principles to the solution of engineering problems. This phase is described in detail in Engineers Ireland's publication *Chartered Engineer – Regulations for the title of Chartered Engineer*.

1.3 Education Standard required for the title Chartered Engineer

(a) The education standard required for the title of Chartered Engineer is as exemplified by a degree in engineering approved by the Council of Engineers Ireland.

(b) Each candidate for election or transfer to the title of Chartered Engineer shall possess one of the following qualifications;

(i) A degree in engineering approved by the Council of Engineers Ireland as satisfying the education standard for the title of Chartered Engineer;

(ii) The Postgraduate Diploma of Engineers Ireland;

(iii) An engineering qualification which Engineers Ireland, through an international agreement, recognises as satisfying the education standard for the title of Chartered Engineer;

(iv) Other engineering qualifications deemed by the Council of Engineers Ireland to satisfy the education standard for the title of Chartered Engineer

1.4 General Description of an Accredited Engineering Degree Programme

An accredited engineering degree programme which meets the education standard required for the title of Chartered Engineer, is one which is approved by the Executive Committee of the Council of Engineers Ireland, on the recommendation of the Accreditation Board, as satisfying the criteria described in Part 1 of this document.

B ACCREDITATION CRITERIA FOR MASTER'S DEGREE (LEVEL 9) PROGRAMS

B.1.5 Programme Outcomes

Engineers Ireland specifies the following programme outcomes which apply to Master's degree engineering programmes (level 9) aimed at satisfying the education standard which will apply to the title of Chartered Engineer from 2013. It is to be understood that these programme outcomes are achieved through the learning outcomes of all modules in all years of the Master's degree programme and any preceding Bachelor's degree programmes. Programmes must enable graduates to demonstrate:

a) Knowledge and understanding of the mathematics, sciences, engineering sciences and technologies underpinning their branch of engineering.

Graduates should have, *inter alia*;
(i) knowledge and understanding of the principles, concepts, limitations and range of applicability of established mathematical tools and methods;
(ii) knowledge and understanding of the theoretical bases and the related assumptions underpinning the engineering sciences relevant to their engineering discipline;
(iii) knowledge and understanding of a wide range of engineering materials, processes and components;
(iv) knowledge and understanding of related developing technologies and how they might impinge upon their branch of engineering;

b) The ability to identify, formulate, analyse and solve engineering problems.

Graduates should, *inter alia*, be able to;
(i) integrate knowledge, handle complexity and formulate judgements with incomplete or limited information;
(ii) create models by deriving appropriate equations and by specifying boundary conditions and underlying assumptions and limitations;
(iii) identify and use appropriate mathematical methods for application to new and ill-defined engineering problems;
(iv) identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques;
(v) develop software tools including numerical techniques to solve engineering problems.

c) The ability to design components, systems or processes to meet specific needs.

Graduates should have, *inter alia*;
(i) knowledge and understanding of design processes and techniques and the ability to apply them in unfamiliar situations;
(ii) ability to apply design methods to unfamiliar, ill-defined problems, possibly involving other disciplines;
(iii) ability to investigate and define a need and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues;
(iv) knowledge and understanding of codes of practice and industry standards and the need for their application;
(v) ability to redesign products, processes or systems in order to improve productivity, quality, safety and other desired needs.

d) The ability to design and conduct experiments and to apply a range of standard and specialised research tools and techniques.

Graduates should, *inter alia*, be able to;
(i) extract, through literature search or experiment, information pertinent to an unfamiliar problem;
(ii) design and conduct experiments and to analyse and interpret data;
(iii) evaluate critically, current problems and new insights at the forefront of the particular branch of engineering;
(iv) incorporate aspects of engineering outside their own discipline and to consult and work with experts in other fields;
(v) contribute individually to the development of scientific/technological knowledge in one or more areas of their engineering discipline.

e) Understanding of the need for high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment.

Graduates should have, *inter alia*;
(i) ability to reflect on social and ethical responsibilities linked to the application of their knowledge and judgements;
(ii) knowledge and understanding of the social, environmental, ethical, economic, financial, institutional and commercial considerations affecting the exercise of their engineering discipline;
(iii) knowledge and understanding of the health, safety and legal issues and responsibilities of engineering practice and the impact of engineering solutions in a societal and environmental context;
(iv) knowledge and understanding of the importance of the engineer's role in society and the need for the highest ethical standards of practice;
(v) knowledge and understanding of the framework of relevant legal requirements governing engineering activities, including personnel, environmental, health, safety and risk issues.

f) The ability to work effectively as an individual, in teams and in multi-disciplinary settings, together with the capacity to undertake lifelong learning.

Graduates should have, *inter alia*;
(i) ability to recognise and make use of the interactions between the engineering technologies and the technologies associated with other disciplines and professions;
(ii) ability to consult and work with experts in various fields in the realisation of a product or system;
(iii) knowledge and understanding of the respective functions of technicians, technologists and engineers and how they together constitute the engineering team;
(iv) knowledge and understanding of group dynamics and ability to exercise leadership;
(v) ability to plan and carry through, self-directed Continuing Professional Development to improve their own knowledge and competence;
(vi) knowledge and understanding of concepts from a range of areas outside engineering.

g) The ability to communicate effectively with the engineering community and with society at large.

Graduates should be able to, *inter alia*;
(i) select and apply appropriate communication tools in order to create deeper understanding and maximum impact on a given audience;
(ii) describe succinctly, the relevant advantages and disadvantages of the various technologies to a lay audience;
(iii) communicate effectively in public, national and international contexts;
(iv) write technical papers and reports and synthesise their own work and that of others in abstracts and executive summaries;
(v) understand the training needs of others in appropriate engineering techniques.

B.1.6 Programme Area Descriptors

B.1.6.1 Engineers Ireland has determined that the study of six Programme Areas is necessary if graduates are to achieve the Programme Outcomes described in B.1.5. Programme Areas are largely coterminous, but it is recognised that occasional overlap is unavoidable.

The Programme Areas are:

(a) Sciences and Mathematics

(b) Discipline-specific Technology
(c) Software and Information Systems
(d) Creativity and Innovation
(e) Engineering Practice
(f) Social and Business Context

B.1.6.2 Programme Area descriptors outline how each Programme Area, through the learning outcomes of its constituent modules, can contribute to the achievement of the Programme Outcomes by the engineering graduate. This process is described below.

(a) Sciences and Mathematics

The study of the sciences provides the basic intellectual tools which graduate engineers use to understand and harness the forces of the world. Students need to develop a good understanding of the sciences in general and, depending on their chosen discipline, they will study specific sciences in greater depth. This understanding forms the basis on which the engineering sciences of their chosen discipline will be further developed, sometimes to the boundaries of the field, within their programme of study. Students should be encouraged to reflect upon standard theories and their inherent assumptions, and, where necessary, adapt them to particular circumstances.

Engineering and science are strongly quantitative, as expressed through the language of mathematics. Engineers need to be numerate and well versed in the mathematical methods required to understand and apply the underlying sciences of their discipline. Students also need the mathematical tools to allow them to develop, validate, apply and adapt models of engineering components and systems in order to achieve optimal design.

(b) Discipline-specific Technology

Technology is commonly perceived in two ways – the sum total of artefacts designed for practical purposes and the knowledge and skills associated with the structure, function, operation and application of practical artefacts. Engineers use science and technology (in both these forms) to create products and systems which themselves often constitute new technologies. It is important therefore that graduate engineers are thoroughly versed in the engineering technologies relevant to their chosen discipline. Examples would include; telecommunications, power systems, control systems, algorithms, data structures, manufacturing processes, highway construction etc. Students should also have the opportunity to become involved in multi-disciplinary projects which require them to draw upon technologies outside their immediate area of interest.

On the skills side of technology, students will need to be able to work with the latest software/hardware and to develop the related skills in the laboratory, workshop and projects.

(c) Software and Information Systems

Software and information systems are used throughout the whole field of engineering to facilitate the solution of engineering problems and the communication of engineering decisions.

The solution of engineering problems is facilitated by techniques such as structured information retrieval and filtering, simulation and quantitative analysis. Engineering students should therefore be taught the theory underlying those software and information systems which are of particular significance to engineering practice. The teaching of these topics will rely heavily on the students' knowledge of the relevant mathematical techniques. Students will also require instruction in the skills of using computers for the quantitative analysis, simulation, and solution of engineering problems. They should be shown how to apply, to adapt and, where necessary, through data exchange, to integrate industry–standard software tools and information systems.

Software, information systems and the electronic encapsulation of knowledge play an important role in the manipulation and communication of engineering information. Students will therefore require skills in the use of software tools like word processors, presentation packages and spreadsheets for these purposes. They should be introduced to a wide range of computer-based data presentation techniques and should learn how to choose the most appropriate one for a particular set of circumstances.

(d) Creativity and Innovation

Research and design are central components of creativity and innovation. Research seeks to generate new knowledge which may lead, through the design process, to new products and systems. This Programme Area should facilitate students' understanding of the experimental method and how its application can lead to new knowledge and insights in an organised way. Students should be exposed to a range of standard and specialised research tools and techniques of inquiry and should have the opportunity to draw up and execute, independently, a research plan.

Design is at the heart of engineering. Design studies should include consideration of the design process and of techniques specific to particular engineering products and processes. Students should be encouraged to think beyond the obvious and routine, and be given opportunities to face the challenges of previously unsolved problems. For example, consideration should be given to including in the programme, the art of problem solving, heuristics, TRIZ, etc. By these means, a student's ability to contribute to the creative process may be developed.

Since engineering is ultimately about practical activities, such innovation should include the practical testing of ideas in the laboratory and conducting research for information to develop these further. These activities should be linked to technical analysis and the critical evaluation of results. Also related to practical issues, students should explore the various steps from idea to marketplace, including patents, business planning and technology transfer. In both research and design, students should have the opportunity to be involved in multi-disciplinary projects.

(e) Engineering Practice

The success of new engineering development is often closely related to earlier experience. Students need to be familiar with general engineering practice and with the particular operational practices of their discipline. Related to this is responding to real life situations and day-to-day management of complex engineering projects – supervising others, dealing with technical uncertainty and having awareness of codes of practice and the regulatory framework. Operational practice will develop students' knowledge of manufacturing or development processes, methods of control of engineering products and processes, the assessment of hazards and operational safety.

Students should be made aware of the practical dimension of their work. Various pedagogical approaches can facilitate the development of this awareness, including case studies, industrial placements, projects, industry speakers, laboratories, workshops and visits to industrial or commercial installations.

(f) Social and Business Context

Engineering is directed to developing, providing and maintaining infrastructure, goods, systems and services for industry and the community. Programmes need to develop an awareness of the social and commercial context of the engineer's work. This includes an understanding of issues relating to today's multi-cultural workforce, of socio-technology and of the constraints on technological developments imposed by health and safety, the environment, codes of practice, politics, the law and financial viability, management issues and the means by which the various risks may be assessed and managed. Students should be made aware of the various methods for the assessment of quality and fitness for purpose of engineering products and systems, and understand how to achieve these attributes in design and development. They should be given ample opportunity to analyse and discuss the ethical consequences of their decisions.

Engineering invariably involves a team approach; it is important therefore that students learn how to work with and for others, both within and outside their own disciplines. They should have some knowledge of team dynamics and should be capable of exercising leadership. Programmes should develop the student's ability to analyse, present and communicate technical information to a range of audiences.

Society expects professional behaviour from its professional engineers and therefore programmes should enable students to become familiar with the expectations and standards inherent in professional codes of conduct.

The importance of students identifying their own learning needs and exercising responsibility for their own continuing professional development should be stressed.

B.1.7 Assessment of Student Performance

Examinations, projects and other assessment instruments should be designed to evaluate the extent to which students can demonstrate achievement of the programme outcomes both throughout the programme and at its conclusion.

The emphasis in examinations should be on analysis and problem-solving and not on the recitation of facts or standard solutions.

The quality assurance process of the programme provider should seek to ensure that adequacy of standards is achieved in all examinations.

B.1.8 Guidelines on Programme Structure and Resources

Engineers Ireland is primarily concerned to ensure that programmes for accreditation are designed so that students are enabled to achieve the programme outcomes specified. It does not prescribe the education standard of students entering programmes and the learning process they undertake during a programme as these are, generally, matters best dealt with by programme providers.

However, the wide experience of Engineers Ireland with accreditation has shown that certain minimum inputs, i.e. entry standards, programme duration and structure and resources including buildings, laboratories, equipment, academic and support staff, have been required in the past if programme outcomes are to be satisfactorily achieved. Those inputs are listed in B.1.8.1, B.1.8.2 and B.1.8.3. If providers wish to propose alternatives they must present a detailed case indicating how programme outcomes will be met.

B.1.8.1 Guidelines on Entry Standards

B.1.8.1.1 The entry standard to an engineering programme should be such that those holding it have a reasonable prospect of understanding the learning materials provided and of achieving the programme outcomes.

B.1.8.1.2 Engineers Ireland accepts the following minimum entry standards:

(a) Five year (300 ECTS Credits) integrated programmes leading to a Master’s Degree.

- A grade D3 or better in four Ordinary Level Leaving Certificate subjects

  Plus

  A grade C3 or better in two Higher Level Leaving Certificate subjects, one of which shall be Mathematics.

  Where an entrant has a C3 in Higher Level Applied Mathematics, a D3 in Higher Level Mathematics is acceptable.

  A pass in an approved entrance examination in Mathematics is acceptable in lieu of the C3 in Higher Level Mathematics.

- A pass in a Foundation Course approved by Engineers Ireland.

- Programme providers may propose alternative entry requirements, which must satisfy the criteria in B.1.8.2.1.

(b) Five year (300 ECTS Credits) programmes leading to a Master’s Degree with a Bachelor’s degree awarded on successful completion of years three or four.
(i) Entry standard for the Bachelor’s Degree is as in B.1.8.2.2 (a).
(ii) Entry standard to the One or Two-year Master’s Degree.

- A pass or better in the Bachelor’s degree.

- A pass or better in a cognate Bachelor’s degree, the entry standard to which is as in B.1.8.2.2 (a).

Note:

Those holding accredited Ordinary degrees (level 7) in engineering would normally be expected to successfully complete an approved programme of Bridging Studies before transferring into the latter stages of a five-year Master's degree programme.

B.1.8.2 Guidelines on Programme Duration and Structure

Engineers Ireland accepts the following durations and structures which are in line with its position on the Bologna Declaration:

a) Five-year (300 ECTS Credits) integrated programmes leading to a Master's Degree.
b) Five-year (300 ECTS Credits) programmes leading to a Master's Degree with a Bachelor's degree awarded on successful completion of years three or four.

B.1.8.3 Guidelines on Resources including buildings, laboratories, equipment, academic and support staff

B.1.8.3.1 Buildings, Laboratories and Equipment

The buildings, laboratories and equipment should be such as to satisfactorily support the learning process of the student in achieving the programme outcomes.

B.1.8.3.2 Academic Staff

There should be sufficient numbers of academic staff to ensure the effective delivery of the programme outcomes.
Staff teaching on engineering degree programmes should:

- Be involved in research work as evidenced by participation in national and international conferences and publishing in refereed journals,
- Be involved with industry by secondment, consulting and ongoing industry-led research,
- Generally, have obtained post-graduate research degrees,
- Be able to demonstrate their professional competence by having undertaken significant post-graduate work in industry/engineering consultancy and/or research and development; this is normally demonstrated through the acquisition of the Chartered Engineer title.
- Have the ability to design, develop and implement courses on an accredited engineering degree programme.

B.1.8.3.3 Support Staff

Engineering programmes require substantial inputs from non-engineering personnel in areas such as mathematics, the sciences, business management and other complementary studies. The quality of such staff is as important as that of the engineering staff and the same general standards apply.
There should be an adequate number of technical and laboratory staff to ensure that there is a satisfactory level of technical support in workshops and laboratories.

B.1.8.4 Guidelines on Student Transfer and Mobility

Engineers Ireland is committed to supporting the policies of the National Qualifications Authority of Ireland in respect of facilitating access, transfer and progression for students. Programme providers should have in place procedures and regulations, consistent with maintaining academic standards, to achieve this.
The principal objective of the Bologna Declaration is to create a European Area of Higher Education in which student mobility easily takes place, primarily by Bachelor degree graduates transferring to Master degree programmes in other European countries.

APPENDIX D – Accreditation Board's strategy to address the longer term issues

(Note: Not part of this consultation process)

CURRICULUM CONTENT ISSUES

Consider the possibility of alternative measurements

- July-September 2016: research on identifying options for alternate curriculum measurement methodologies
- September-October 2016: discussions by the Accreditation Board
- November 2016: discussions with NCDEAS to finalize methodologies
- January-April 2017: consultation with the regulators
- May- July 2017: finalize the report in order to present recommendations
- October 2017: Engineers Canada board approval

WORKLOAD ISSUES

More collaborative/transparent process with stakeholders

- Refine sampling methodologies
- Streamline the on-site visit schedule
- Prior review of visit materials (online review by visiting teams)
- Development of training materials and enhanced training for all participants
- Ongoing consultation with NCDEAS on bringing greater efficiencies to the process
- Accreditation related workloads will be reduced to prior levels in the early 2010s, or lower, i.e. before the introduction of dual input and outcomes accreditation criteria

PROPOSED CHANGES TO CRITERIA AND SECTION 4

Preamble. This is a consolidated list of changes discussed by the Canadian Engineering Accreditation Board at a face-to-face meeting on August 18, 2015. Text in red has been changed or moved.

3. Accreditation criteria

The following sections describe the measures used by the Accreditation Board to evaluate Canadian engineering programs for the purpose of accreditation.

3.1 Graduate attributes

The institution must demonstrate that the graduates of a program possess the attributes under the following headings. ~~The attributes will be interpreted in the context of candidates at the time of graduation. It is recognized that graduates will continue to build on the foundations that their engineering education has provided.~~

#1 Knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

#2 Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.

#3 Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.

#4 Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.

#5 Use of engineering tools: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.

#6 Individual and team work: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.

#7 Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

#8 Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.

#9 Impact of engineering on society and the environment: An ability to analyze societal and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, ~~social~~ health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions and the concepts of sustainable design and development and environmental stewardship.

#10 Ethics and equity: An ability to apply professional ethics, accountability, and equity.

#11 Economics and project management: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.

#12 Life-long learning: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

The attributes will be interpreted in the context of candidates at the time of graduation. It is recognized that graduates will continue to build on the foundations that their engineering education has provided.

To assess the suitability of a program for developing the above list of attributes, the Accreditation Board will rely on criteria 3.1.1 to 3.1.5, given below, and on the *Interpretive Statement on Graduate Attributes* which is attached as an appendix to this document.

3.1.1 **Organization and Engagement:** There must be demonstration that an organizational structure is in place to assure the sustainable development and measurement of graduate attributes. There must be demonstrated engagement in the processes by faculty members and engineering leadership.

3.1.2 **Curriculum Maps:** There must be documented curriculum maps showing the relationship between learning activities for each of the attributes and the semesters in which these take place.

3.1.3 **Indicators:** For each attribute, there must be a set of measureable, documented indicators that describe what students must achieve in order to be considered competent in the corresponding attribute.

3.1.4 **Assessment Tools:** There must be documented assessment tools that are appropriate to the attribute and used as the basis for obtaining data on student learning with respect to all twelve attributes over a cycle of six years or less.

3.1.5 **Assessment Results:** At least one set of assessment results must be obtained for all

twelve attributes over a cycle of six years or less. The results should provide clear evidence that graduates of a program possess the above list of attributes.

3.2 Continual improvement

Engineering programs are expected to continually improve. To evaluate this criterion, the Accreditation Board will rely on criteria 3.2.1 to 3.2.3 given below and on the *Interpretive Statement on Continual Improvement*, which is attached as an appendix to this document.

3.2.1 **Improvement process**: There must be processes in place that demonstrate that program outcomes are being assessed in the context of the graduate attributes, and that the results are validated, analyzed and applied to the further development of the program.

3.2.2 **Stakeholder engagement:** There must be demonstrated engagement and involvement of stakeholders both internal and external to the program in the continual improvement process.

3.2.3 **Improvement actions**: There must be a demonstration that the continual improvement process has led to consideration of specific actions corresponding to identifiable improvements to the program and/or its assessment process. This criterion does not apply to the evaluation of new programs.

3.3 Students

Accredited programs must have functional policies and procedures that deal with quality, admission, counselling, promotion and graduation of students. Although all accreditation criteria connect directly and indirectly with their education, particular attention is drawn to admission, promotion and graduation, and academic advising ~~counselling and guidance~~.

3.3.1 **Admission:** No change

3.3.2 **Promotion and graduation:** ~~There must be documented p~~ Processes and policies for promotion and graduation of students must be documented. The institution must verify that all students have met all its regulations for graduation in the program identified on the transcript and that the curriculum followed is consistent with that of the accredited program. The program name must be appropriate for all students graduating from the program.

3.3.3 **Academic Advising**: There must be processes and sufficient resources in place for the academic advising of students. Clear statements of such policies or procedures should be available to faculty and students. Depending on the governance structures in place, aspects of student advising should normally be at both the program and Faculty levels.

3.3.4 Degree auditing: No change

3.4 Curriculum content and quality

The curriculum content and quality criteria are designed to assure a foundation in mathematics and natural sciences, a broad preparation in engineering sciences and engineering design, and an exposure to non-technical subjects that supplement the technical aspects of the curriculum. All students must meet all curriculum content and quality criteria. The academic level of the curriculum must be appropriate to a university-level engineering program.

3.4.1 **Accreditation units (AU)** No change

3.4.2 **Minimum curriculum components:** No change

3.4.3 **A minimum of 420 AU of … mathematics and natural sciences:** No change

3.4.4 **A minimum of 900 AU of … engineering science and engineering design:** No change

3.4.5 **A minimum of 225 AU of complementary studies:** Complementary studies include humanities, social sciences, arts, management, engineering economics and communications that ~~to~~ complement the technical content of the curriculum.

3.4.5.1 While considerable latitude is provided in the choice of suitable content for the complementary studies component of the curriculum, some areas of study are essential in the education of an engineer. Accordingly, the curriculum must include studies in the following areas:

a. Communication skills

b. Professionalism

c. Impact of ~~technology~~ engineering on society

d. Health and safety

e. ~~Professional~~ Ethics, equity and law

f. Environment and sustainability

g. Engineering economics and project management

h. Subject matter that deals with methodologies and thought processes of the humanities and social sciences

3.4.5.2 No change

3.4.6 The program must have a minimum of 1,950 accreditation units…: No change

3.4.7 Appropriate laboratory experience…: No change

3.4.8 Requirements for curriculum content must be satisfied by all students …: No change

3.5 *Program Environment*

3.5.1 Quality of the educational experience:

3.5.1.1 No change

3.5.1.2 The quality, suitability, and accessibility of the:

a. laboratories

b. library

c. computing facilities

d. student counselling services

e. other supporting facilities

3.5.2 Faculty: No change

3.5.3 Leadership: No change

3.5.4 Expertise and competence of faculty:

Faculty delivering the engineering curriculum are expected to have a high level of expertise and competence, and to be dedicated to the aims of engineering education and of the self-regulating engineering profession, which will be judged by the following factors:

a. The level of academic education of its members.

b. The diversity of their backgrounds, including the nature and scope of their non-academic experience.

c. Their ability to communicate effectively.

~~Their experience in teaching, research and design practice.~~

~~Their level of scholarship as shown by scientific, engineering, and professional publications.~~

d. Their experience and accomplishments in teaching as well as in research and/or engineering practice

e. Their degree of participation in professional, scientific, engineering, and learned societies.

~~Their personal interest in, and documented support of, the curriculum and program- related extra-curricular activities.~~

f. Their appreciation of the role and importance of the self-regulating engineering profession, and of positive attitudes towards professional licensure and involvement in professional affairs.

3.5.6 Financial resources: No change

3.5.7 Authority and responsibility for the engineering program: No change

3.5.8 Curriculum committee: Engineering program curriculum changes are expected to be overseen by a formally structured curriculum committee. The majority of the voting members of the committee are expected to be licensed professional engineers in Canada, preferably in the jurisdiction in which the institution is located. In those jurisdictions where the teaching of engineering is the practice of engineering, they are expected to be licensed in that jurisdiction.

3.6 Additional Criteria

3.6.1 For purposes of accreditation, a program is characterized by a formally approved and published curriculum that is regarded as an entity by the institution and that can be considered independently. All options in the program are examined. Following the principle that a program is only as strong as its weakest link", a program is accredited only if all ~~such~~ options meet the criteria.

3.6.2 An accredited program must have the word “engineering” in its title.

3.6.3 The title of an accredited engineering program must be properly descriptive of the curriculum content.

3.6.4 If a program, by virtue of its title, becomes subject to the content requirements for two or more engineering curricula, then the program must meet the Accreditation Board requirements for each engineering curriculum named.

3.6.5 The Accreditation Board must have evidence that all engineering options contain a significant amount of distinct curriculum content and that the name of each option is *descriptive* of that curriculum content. An *Interpretive statement on curriculum content for options and dual-discipline programs* is attached as an appendix to this document.

3.6.6 The Accreditation Board must have evidence that the program name is appropriate for all students graduating in the program regardless of the option taken.

4 Accreditation policies and procedures

The accreditation process comprises two parts: program evaluation by a visiting team and accreditation decision by the Accreditation Board. The evaluation of the program is based on detailed data provided by the institution and on the collective opinion of the members of the visiting team. The accreditation decision is made by the Accreditation Board based on qualitative and quantitative considerations, including the **program's** responses or clarifications to the visit report.

4.1 Initiation and timing of accreditation visit

An accreditation assessment is initiated only at the invitation of an institution and with the consent of the appropriate member of Engineers Canada. Accreditation applies only to programs, not to departments or faculties. The Accreditation Board does not evaluate or accredit non-engineering degrees, diplomas, or certificates or components thereof; only the engineering degree will be included in the list of accredited programs provided in the Canadian Engineering Accreditation Board *Accreditation Criteria, Policies and Procedures* that is published annually.

An accreditation visit to assess or reassess an engineering program or programs normally takes place in October or November. A request from the institution for such a visit must be received by the Accreditation Board Secretariat by January 1 of the calendar year in which the visit is to take place. Accreditation of a program is granted only after students have graduated from the program. For new programs, an accreditation visit may be undertaken in the final year of the first graduating class.

4.2 Selection of visiting team No change

4.3 Preparation for accreditation visit No change

4.4 Accreditation visit No change

4.5 Visiting team report No change

4.6 Accreditation decision No change

……

4.6.1 Accreditation of a program is granted for a specific term; the maximum term is six years.

4.6.2 No change

4.6.3 No change

4.6.4 No change

4.6.5 The Accreditation Board reserves the right to alter the accreditation status of any program at any institution if the program is not in compliance with any of the Accreditation Board's accreditation criteria or regulations.

4.7 Significant Change

Any significant change that takes place during the term of accreditation of an accredited engineering program must be reported to the Accreditation Board. Any change related to an aspect referred to in the *Accreditation Criteria and Procedures* and related regulations is a significant change giving rise to the reporting obligations and may necessitate an immediate reassessment. Any change in the title of an accredited program requires approval by the Accreditation Board for that program's continued accreditation. When an institution supplies information for the renewal or extension of accreditation, it has an obligation to highlight and notify the Accreditation Board of any changes to the program. An *Interpretive statement on significant change* is attached as an appendix to this document.

4.8 Formal review No change

4.9 Informal evaluation or visit No change

4.10 Publication No change

APPENDIX F – Questions & Answers

1. **Does this consultation cover all of the accreditation criteria?**

   No, the consultation is limited to the measurement of curriculum content. Institutions are required meet the standards established in the following area:

   a. **Graduate attributes** - institutions must demonstrate that the graduates of a program possess the attributes 12 distinct areas.

   b. **Continual improvement** - Engineering programs are expected to continually improve. There must be processes in place that demonstrate that program outcomes are being assessed in the context of the graduate attributes, and that the results are applied to the further development of the program.

   c. **Students** - Accredited programs must have functional policies and procedures that address quality, admission, counselling, promotion and graduation of students.

   d. **Curriculum content and quality** - All students must meet all curriculum content and quality criteria designed to assure a foundation in mathematics and natural sciences, a broad preparation in engineering sciences and engineering design, and an exposure to non- technical subjects that supplement the technical aspects of the curriculum

   e. **Program environment** – AB considers the overall environment, in which an engineering program is delivered, including moral, accessibility of facilities, qualifications, expertise and availability of faculty, and financial resources.

2. **Do other accreditation systems around the world that use outcome measures also measure curriculum content** (i.e. two systems – graduate attributes and curriculum content)?

   Yes, all systems have a measure of curriculum content. For example, section C.2.2.6 of the Washington Accord states: provide the criteria for accreditation/recognition (general, program specific; curriculum content technical and non-technical; incorporation of practical experience; length of the program; naming of the program; faculty requirements).

3. **The document mentions that workload is a long-term issue and out of scope for this consultation. How do I pass along my suggestions to streamline accreditation processes?**

   We are always looking for ways to improve the processes. Please email your suggestions to consultation@engineerscanada.ca

4. **What is an Accreditation Unit? Why was it developed?**

   Section 3.4.1 *Approach and methodologies for quantifying curriculum content* of the Accreditation Criteria and Procedures Report 2015 fully defines Accreditation Units

   3.4.1.1 **Accreditation units** (AU) are defined on an hourly basis for an activity which is granted academic credit and for which the associated number of hours corresponds to the actual contact time between the student and the faculty members, or designated alternates, responsible for delivering the program:

- one hour of lecture (corresponding to 50 minutes of activity) = 1 AU
- one hour of laboratory or scheduled tutorial = 0.5 AU

This definition is applicable to most lectures and periods of laboratory or tutorial work. Classes of other than the nominal 50-minute duration are treated proportionally. In assessing the time assigned to determine the AU of various components of the curriculum, the actual instruction time exclusive of final examinations should be used.

The sections 3.4.1.2, 3.4.1.3 and 3.4.1.4 set out how methods for determining an equivalent measure in AU is a calculation on a proportionality basis for content that is not measured in contact hours.

The system of using AUs to measure curriculum content is unique to Canada. Institutions have a variety of ways of measuring curriculum content. A simple term like credit hours means have different meaning. Semester lengths range from 12 -15 weeks. Credit hours range from 120 to 150 hours for equivalent programs. The system of AU was developed to normalize the measurement of curriculum content.

5. The document refers to "concept of a minimum 16 years total education". What does this mean?

The 16 years refer to totally schooling that includes four years post-secondary. In some jurisdictions, it means grade 1 through to grade 12 + 4 years at university. In Quebec, it means grade 1 through to grade 11, plus two years at CEGEP and 3.5 years at university.

6. I understand that the AU system has a K factor to provide flexibility to the institutions. How does it work?

The details are set out in the accreditation criterion.

3.4.1.3 One method for determining an equivalent measure in AU is a calculation on a proportionality basis. This method relies on the use of a unit of academic credit defined by the institution to measure curriculum content. Specifically, a factor, K, is defined as the sum of AU for all common and compulsory courses for which the computation was carried out on an hourly basis, divided by the sum of all units defined by the institution for the same courses. Then, for each course not accounted for on an hourly basis, the number of AU is obtained by multiplying the units defined by the institution for that course by K.

Σ AU for all common and compulsory courses for which the computation was carried

K = out on an hourly basis Σ units defined by the institution for the same courses

Pages 65 to 68 of the Accreditation Criteria and Procedures 2015 provides a further explanation and illustrative examples of the use of the K-factor.