Consultation Group – Engineering Instruction and Accreditation

Supplementary Q&As

1) What initiated the change in emphasis from AUs to learning outcomes?

In the mid-2000s, it became increasingly apparent that most other leading countries (i.e. Washington Accord countries) were placing more emphasis on learning outcomes as a means of assessing quality of engineering education. In 2008, with expert advice from CEAB and NCDEAS, the Board of Engineers Canada took the strategic decision to evolve the Canadian accreditation system by adding "program-level outcomes" to measure achievement of competencies and to gradually shift emphasis from input measurements (AUs) to "course-level outcomes", expressed in terms of graduate attributes. These outcomes formally became part of accreditation assessments as of 2015. Since that decision, considerable effort has been invested by these bodies in laying the foundations by developing the 12 graduate attributes which describe the desired outcomes of an effective engineering program. See graduate attributes.

2) What is the problem with simply continuing to use AUs, a system which we know works well?

In general, performance specifications are superior in achieving desired results than are input specifications: AUs are a measure of educational inputs. The AU-only approach does not reflect international best practices, in particular among our Washington Accord colleagues. The last Washington Accord (WA) review approved the Canadian system, but was accompanied by a very strong suggestion to address the "over emphasis on inputs" (AUs) by the next review in 2020.

Internationally, the accreditation process typically has the following components, typically in combination with de-emphasized numerical measurements of hours of study:

- Learning outcomes of the program(s) ,
- Teaching and learning processes,
- Assessment strategies employed,
- Human, physical and material resources involved,
- Professional registration of its instructors,
- Internal regulations regarding progression and the award of degrees,
- Quality assurance arrangements,
- Evidence that the program is at the appropriate level of the relevant framework for postsecondary education qualifications in the province, region or nation,
- Entry to the program and how cohort entry extremes are supported, and
- How previous accreditation recommendations and requirements have been dealt with.

AU's are a measure of time spent and not educational achievement. They do not provide sufficient information about whether programs are effective in stimulating students to learn. For the first time (i.e. starting in 2015) the accreditation process includes measures of what students in a program actually learn, through assessment of learning outcomes and graduate attributes. Therefore, there is no longer a need for the same type of intensive specification of inputs as done prior the introduction of graduate attributes; the AB has proposed a number of options to simplify the measurement of content.

In terms of the “minimum path”, the visitation questionnaire now requires course-level learning outcomes to be specified and measured. Assuring that every student has met all course-level learning outcomes in every course remains central to the process of certifying individual students.

3) What is the rush to make a change – why not take the time to develop the long term solution so that only one change need be made?

It is anticipated that identifying and getting consensus on the optimal long term solution could take some time. However, there is an urgent short-term need to identify a path forward to reduce workloads and to reduce the perception of risk felt by some programs in using the existing flexibility in the content criteria. The present over-constrained dual model of both inputs- and outputs-based assessment is creating unsustainably heavy workloads on the HEIs as well as the visiting teams. Additionally, the dual model lacks the necessary flexibility for educational innovation, alternative forms of program delivery, and ability to complement technology-focused studies with other studies to achieve the full potential of graduate attributes.

Additionally, a certain measure of expediency is required as we prepare for the next cycle of monitoring by our international counterparts (signatories of the Washington Accord). During our last review, they strongly suggested we look at our "over-emphasis" on inputs. To have an appropriate response in place and operational before the next review (2020?), we need to act quickly.

4) How is the additional curriculum defined or described to ensure engineering quality standards meet the Washington Accord.?

Additional Relevant Learning refers to “content at a university level” and to “material appropriate to engineering education”. Canadian Accreditation Criteria are now and will continue to be fully compliant with the Washington Accord requirements.

5) 5) Please give examples of courses or learning experiences that are acceptable under the current “405 AU” content measurement approach. Is it expected that there would be material changes to these types of courses / learning experiences under the proposed “8 semesters” content measurement approach?

A June 2007 document from the Royal Academy of Engineering, “Educating Engineers for the 21st Century” makes the case for improving engineering education. Engineering today is characterised by both a rapidly increasing diversity of the demands made on engineers in their professional lives and the ubiquity of the products and services they provide.

Twenty-first century engineering businesses seek engineers with abilities and attributes in two broad areas - technical understanding and enabling skills. The first of these comprises: a sound knowledge of disciplinary fundamentals; a strong grasp of mathematics; creativity and innovation; together with the ability to apply theory in practice. The second is the set of abilities that enable engineers to work effectively in a business environment: communication skills; team- working skills; and business awareness of the implications of engineering decisions and investments.

It is this combination of understanding and skills that underpins the role that engineers now play in the business world, a role with three distinct, if interrelated, elements: that of the technical specialist imbued with expert knowledge; that of the integrator able to operate across boundaries in complex environments; and that of the change agent providing the creativity, innovation and leadership necessary to meet new challenges.

Disciplinary fundamentals are specified in the 1545 AU Core Technical Curriculum: the additional content in a four-year/eight-semester engineering degree program will educate engineers to be integrators and change agents. Course content could include insights into innovation and entrepreneurship, globalization and international experiences, major design opportunities, and coop experiences.

6) Under the proposed approach, how would AB evaluate whether the course content under Additional Relevant Learning meets the intent of the proposed 3.4.6?

The proposal is 1545 AUs prescribed and 4 years / 8 semesters (or equivalent). There would not be any further counting of AUs for the Additional Relevant Learning. The AB would assess whether the additional courses, taken as a whole

- "Top up" the Core Technical Curriculum (1545 AU) to complete a minimum of eight semesters;
- are at a university level (academic credit given by HEI)
- are relevant to engineering education.

7) What is the definition of "quality"? What is the worst case of the 405 AUs, i.e., all language, all management, all history?

A legalistic interpretation of the current criteria suggests the 405 AUs could be all language, all management, all history. In practice, reason has prevailed and this has not occurred.

In practice 1700-1750 AU are needed to ensure that all AB content-category minima are met so the "free" content is 200-250 AU (typically 4-5 courses). History, management and languages all satisfy the definition of CS. Some programs have successfully used this "free-space" to create embedded options in "Entrepreneurship", "Management" and "Communication" where content is delivered by faculties outside engineering. Some programs count credit for one or two graduate courses in the "Other" category.

8) Does additional curriculum need to be developed according to the interpretive statement? What would be a reasonable time frame?

Curriculum currently included in existing programs would meet the proposed criteria for Additional Relevant Learning. The change is to the accounting units not the quality or quantity of content.

9) How will the proposed approach alleviate the workload issues on the HEI and the visiting team?

The proposed interim short-term solution (1545 AUs) does not directly alleviate the workload issues. However, it provides a viable transition from "time-based" content measurement to "course-level learning outcomes", plus forward-looking vision to a long-term solution that aims to reduce workloads back to levels before the introduction of outcomes based criteria (i.e. early 2010s). HEIs and visiting teams will feel a sense of worthwhile perseverance in waiting a little longer for the workload problems to be fully addressed when they can see a long-term solution is in progress. The sooner a long term solution can be achieved, the better for all concerned.

10) How will the proposed approach allow the HEIs more freedom than the current approach to undertake "educational innovation"?

By clarifying what is acceptable and thus reducing the risk perceived by some HEIs, the proposed approach to Additional Relevant Learning will facilitate renewal of curriculum and addition educational innovations to achieve graduate attributes. This includes alternative forms of program delivery (such as active independent learning, experiential learning, project based learning, MOOCs, etc.) and an ability to better complement technology-focused studies with other studies (e.g., management, social sciences, entrepreneurship, research, etc.). Converting course activities is not an exact process, particularly when a course is not simply "lectures and labs". The flexibility to use "academic credit" (courses) in place of AUs within Additional Relevant Learning accepts that HEI assignment of credit takes appropriate account of any university-level learning mode.

11) CEAB needs to thoroughly train Program Visitors to become experts in evaluating content (AUs) and competencies (Graduate Attributes).

Training for Program Visitors is a valid point; equally important is moving quickly to simplify and stabilize content measurement. We now have a very clear rubric for visitor review of program outcomes (GAs and CI) and a detailed visiting team manual addressing GA/CI. The pool of visitors who have experience of our GA/CI assessment process is small but growing.

12) In the view of the Consultation Group (representing AB, Deans, Constituent Associations and the EC Board), will implementation of the proposed approach compromise the "accreditation deliverable" upon which Boards of Examiners rely? (The deliverable: identification of programs whose graduates are academically qualified,)

The core curriculum components in Engineering Science, Engineering Design, Mathematics, Natural Sciences, and Complimentary Studies (totaling 1545 AUs) would remain unchanged. The 20% Additional Relevant Learning may evolve, but courses will continue to at the university level and relevant to engineering. Individual students will continue to hand in assignments, write exams and do group projects – in other words, the individuals whom the BofE will be considering will continue to demonstrate that they have mastered the minimum path by achieving passing marks for a four year/eight semester engineering education which is "80%" Core Technical Curriculum and "20%" Additional Relevant Learning.

The Consultation Group believes that the overall quality of the engineering degree and its value to society will improve under the proposed changes. Engineering programs will continue to be at least 4 years / 8 semesters (or equivalent). HEIs will have some latitude to differentiate themselves and allow students to specialize in particular fields of endeavor based on the local strengths and interests of their Faculty and University. Students will have the ability to complement their technology-focused studies with other studies (e.g., management, social sciences, entrepreneurship, research) and to pursue studies elsewhere in the world through exchange programs, to better prepare them to enter the global marketplace and their chosen area of practice. BofE can be confident that students graduating from all accredited institutions will continue to have the necessary body of knowledge based on commonly accepted engineering principles and the evolving needs of society.

13) Why is there a 4 year / 8 semester requirement - if the curriculum can be delivered in less elapsed time, why isn't that acceptable?

Four years (or more) is a commonly accepted benchmark around the world, likely to deliver a mature individual with a solid technical background (curriculum) in a program that has also demonstrated a reasonable level of achievement for all 12 graduate attributes. It is unlikely that this can be achieved by typical students in less than four-years. (In Quebec, CEGEP can reduce this university requirement to seven semesters because of the additional learning time beyond Grade 12.) Some keen students might speed through the courses in less than four-years, but there is more to the preparation of an engineer than passing exams.

14) Doesn't WA accept successful written exam results such as FE which don't have any time period associated with them?

No, the Washington Accord is a mutual recognition agreement for engineering accreditation systems. To become a signatory, applicants are required to show that programs are offered at an appropriate tertiary-level institution. The duration of academic formation will normally be at least sixteen years, which for most of Canada is grades 1-12 plus four years postsecondary education.